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The MODEL ENGINEER & PRACTICAL ELECTRICIAN

A Journal of Small Power Engineering

Founded 1898

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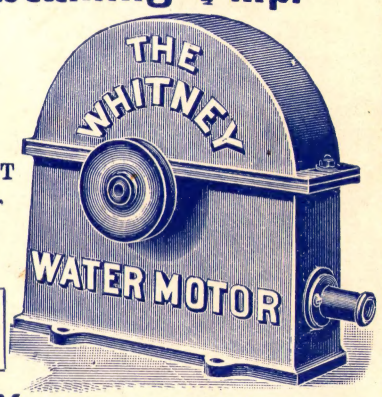

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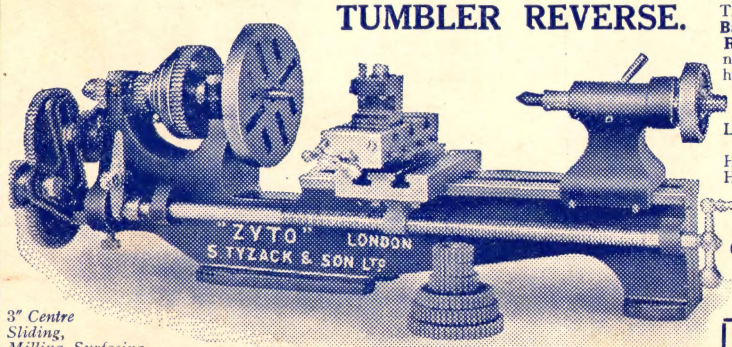

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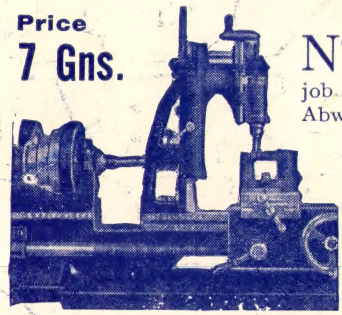

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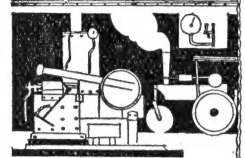

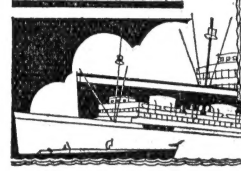

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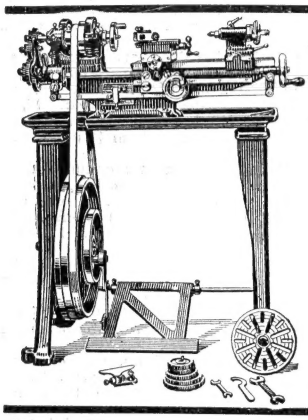

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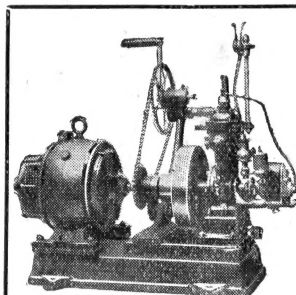

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(*Continued on page* vii).

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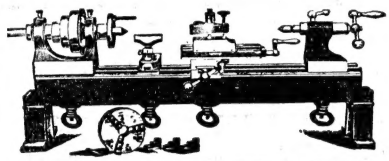
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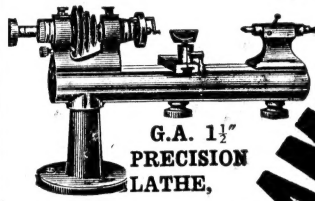
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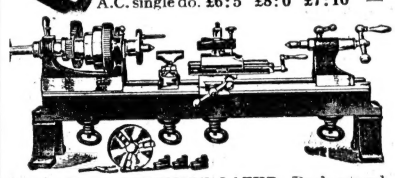
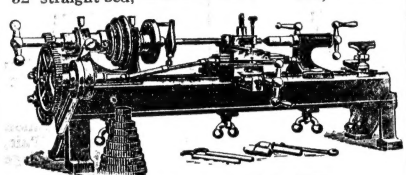

MODEL D PRECISION LATHE, Back-geared, 3¼" centres, 32" straight bed, £25 : 10. Gap bed, £28.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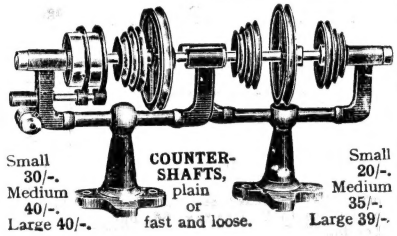
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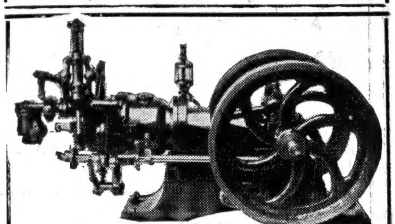
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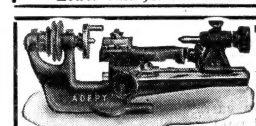
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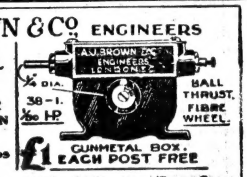

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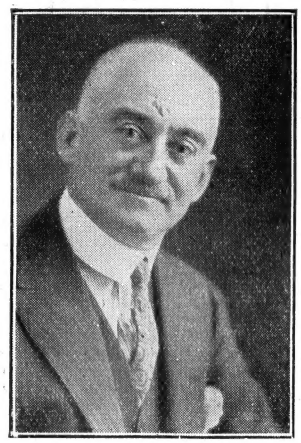

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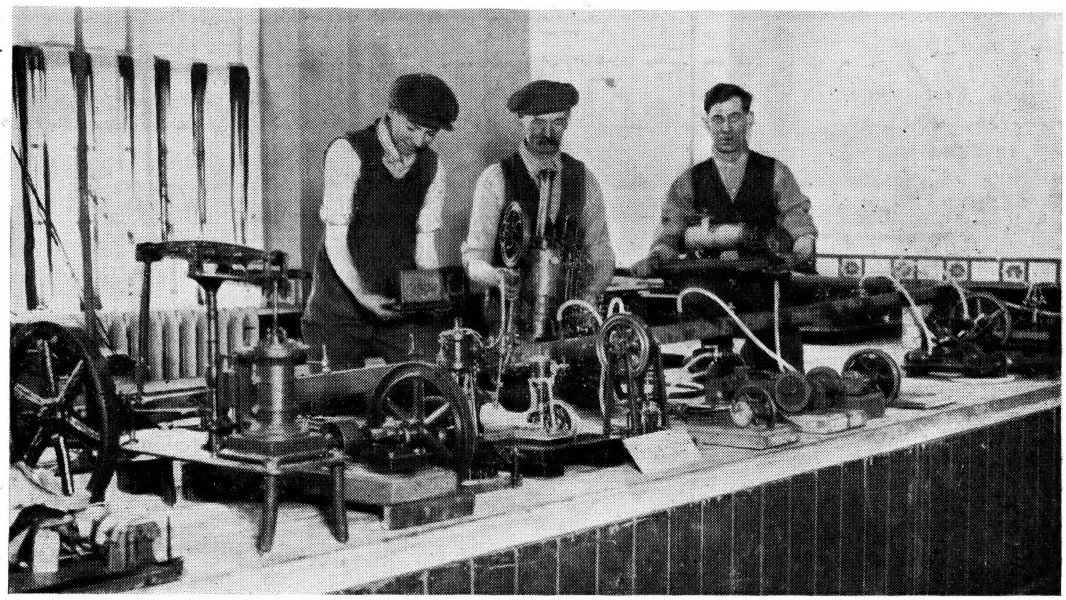
SMOKE RINGS

I AM indebted to Mr. Wilfred Day, F.R.P.S., F.R.S.A., for an autographed copy of a very remarkable book. Mr. Day is well known to many of my readers, not only through the prominent position he occupies in the wireless industry but also because of his keen enthusiasm for model engineering and the excellent examples of his own craftsmanship which he has shown at our Exhibitions. The book I have just received reveals another of Mr. Day's activities of a very exceptional character. It is a catalogue of a complete collection of cinematograph and moving-picture equipment and literature which is now housed in the Science Museum at Kensington under the title of the Will Day Historical Collection. After devoting many years of his life, and a considerable amount of money, to the acquisition, identification, and classification of this historical material, Mr. Day feels that it would be appropriate that it should be acquired by some national museum, or by some individual or organisation associated with the moving-picture industry, so that it may be permanently preserved as a unique record of the origin and growth of the cinematograph from the earliest times to its present-day perfected form. Tenders are therefore being invited for the purchase of the collection, and the volume I am writing about is the official catalogue for the guidance of prospective buyers. The book in itself is a fascinating study. It contains no less than 56 pages and describes 445 items in the collection. In a foreword, Mr. Day writes very instructively about the history of moving pictures. He makes the surprising statement that there is evidence that as far back as 25,000 years B.C. the depiction of motion in pictorial form was thought of. Chinese shadowgraph apparatus is known to have existed as far back as 5,000 B.C., while about the year 400 B.C., the invention of glass and of the first lens, and also the discovery of frictional electricity, were important factors in subsequent motion-picture progress. A very early moving-picture machine was illustrated in a book printed at Rome in 1640, and one hundred and sixty years later Professor Child invented the bi-unial lantern. Subsequent important steps in progress were the patenting of celluloid film in ribbon form in 1887, and the introduction of the first commercial cinematograph machine by Friese-Greene in 1889. Mr. Day pays an appropriate tribute to other inventors, including Edison, Hepworth, R. W. Paul, and Birt Acres, for their share in perfecting moving-picture projection. A number of plates in the book illustrate notable items in the collection. It is obvious at a glance how much patient painstaking work Mr. Day must have put into the preparation of this wonderful collection, and how much research must have been necessary to verify and classify the items, and to fill up gaps in the chain of regular development. Mr. Day writes me: "You will be able to see some of the terrific research I have put in, in this all-absorbing subject, and you will perhaps gather from that how much I owe to model-making and its attendant throes as a panacea to my mind. Often-times I have become obsessed with my deep research work till right into the small hours of the morning, and I have been forced to give up further research for the time being and take up my hobby of model-making to rest my mind." The bringing together of this unique collection is a work of which Mr. Day may well be proud, and I hope that it will eventually find a suitable permanent home where it will be accessible to the public. The auctioneers who are instructed to receive tenders are Messrs. Harris & Gillow, 80-82, Wardour Street, London, W.1. The catalogue is priced at 5s.



Arranging the Working Models at the Pinxton Exhibition.

IT is a somewhat curious coincidence that just after I had written my recent article on "The Spirit of THE MODEL ENGINEER," I should receive a striking example of that spirit in action. Mr. S. L. Whiteford, of Mount Darwin, Southern Rhodesia, sent me a letter he had received from another reader of THE MODEL ENGINEER in Western Australia, giving him some useful advice on a gas engine difficulty which Mr. Whiteford had ventilated in our columns. Imagine the circuit set up: Mr. Whiteford writes in the first instance from Southern Rhodesia to THE MODEL ENGINEER in London; THE MODEL ENGINEER containing his letter goes out to a little township in Western Australia, and from that remote spot another letter goes across the world to Southern Rhodesia. Mr. Whiteford says that it is lucky the letter reached him at all, as it was addressed only to him in Southern Rhodesia, and that is a pretty big country for a letter to find a man when no town or district is indicated. The Australian correspondent was Mr. M. R. Oliver, of East Northam, and he will be glad to know that his kindly letter of advice was duly received and much appreciated.

* * *

I AM glad to be able to report that the Model Engineering Exhibition recently held at Pinxton, Notts., proved a great success. The photograph herewith shows some of the engineering models being arranged for running from the compressed-air service. Mr. T. Pearson, the President, showed an electrically-driven scale model of the famous "Flying Scotsman" railway engine, complete with automatic couplings. A miniature electric railway and a small canal, on which various types of boats were plying up and down were other attractions.

Percy Marshall

The British Journal Photographic Almanac, 1930.

One would almost think that photography had become such a useful and everyday occurrence that, as a novelty upon which to make a big book, it must be almost exhausted. This is disproved, however, by the publication of the sixty-fourth issue of "The Almanac" in its present form, and the twenty-fifth year of its issue under the present editorship. It contains 784 pages crammed with good things and new ideas. Of this, 320 pages are devoted to text, in which the editor, Mr. G. E. Brown, F.I.C., Hon. F.R.P.S., reviews his twenty-five years, and the rest, of photographic history; Mr. T. S. Bentley, A.R.C.S., B.Sc., writes on "Telephotography"; and Mr. David Charles records, by a number of interesting illustrations, all kinds of gadgets which have, and may occur, in his, and all photographic experiences. Then there are sixty-three photogravures by the Vandyk Printers, Ltd.; and Mr. Pierce writes on "Interior Photography." The usual features of "Epitome of Progress," "New Goods," "Formulæ," "Tables," and "Miscellaneous information" complete with the advertisements the usual mass of information the serious photographer cannot neglect or do without.

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WORKSHOP TOPICS

Hammering Out a Coping for Firebox Lagging from Brass Plate.

By G. Gentry.

THIS job, which is of special interest from a practical point of view, is incidental to the reconstruction of the well-known No. 1 loco model now in the hands of the brothers Willoughby. It is the work of Mr. G. S. Willoughby, who, for the time being, is working single-handed on the model, as his brother finds business leaves no margin for spare-time occupations.

The model, as originally constructed, with a copper boiler, had no lagging, but was painted directly on the plates. In the restoration it was decided to supply this lagging complete, so that when finished there will be a layer of felt over both the shell and wrapper of firebox. Over this again is a layer of stout cartridge paper, which has been varnished. Then over that will be fitted No. 22 S.W.G. brass lagging plates, confined by steel bands. At the smokebox end is fitted a brass turned ring, which takes the place of a coping ring, but at the raised firebox wrapper and shell junction is fitted a horseshoe-shaped coping, of curved angle section, and it is the making of this that forms the subject of this note. Where it runs over the wrapper lagging it butts against the wrapper lagging plate, and is there kept down by a steel strip, half over each edge. Where it bridges over the shell it passes down end on to the paper and felt lagging, and nearly touches the boiler shell plate, but not quite.

Fig. 1 is a photo of the finished job, taken after it had been fitted. As shown here, the horns of the horse-shoe are set in towards each other a little, as there is this slight set-in in the shape of the firebox wrapper, otherwise it conforms to the cross-section as given in the lower view of Fig. 2 (full size). The view to the right bottom in Fig. 3, gives the proportions of the job, as shown in Fig. 1. From this it will be seen that the curvature of the firebox wrapper is struck from a centre $\frac{1}{8}$ in. higher up than the centre of the boiler shell, from which the inner curve of the coping is described. This makes the front of width of the coping $\frac{1}{8}$ in. more at the top than at the sides. The peripheral width of coping is $\frac{5}{8}$ in., and therefore the upper cross-section of Fig. 2 is the vertical cross-section at top, showing the coping $\frac{1}{2}$ in. wide, and the lower view, a horizontal cross-section of a wing, showing the width $\frac{3}{8}$ in. wide on front. The inside curvature, as hammered, is 9/32nd-in. radius, and the thickness (at first) of the coping is 20 S.W.G., or a full 1/32nd in.

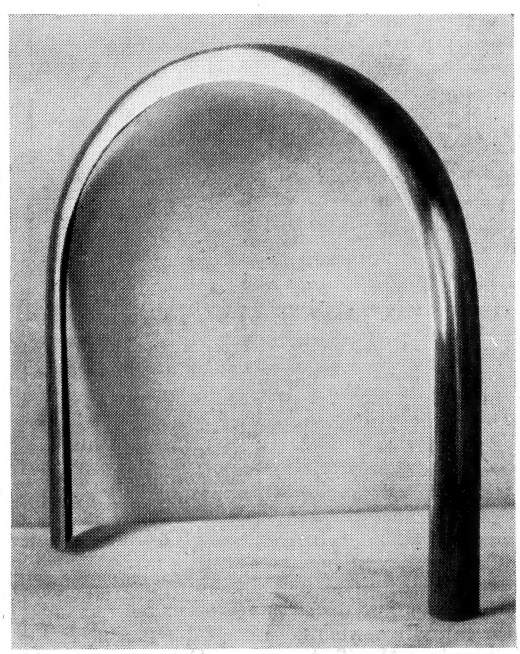


Fig. 1.—The Finished Coping for Firebox Lagging.

As will be seen, the operation of hammering over, tends to crowd the metal, and therefore thicken it, but what actually takes place is that the material is stretched outward, keeping its thickness about the same, but the final draw-filing brings it down to about equal to No. 22 S.W.G. so that it matches in this respect the metal lagging cover of the firebox wrapper.

The Former for Hammering.

Referring to the upper two views of Fig. 3. These give the details of the former for hammering the plate to shape. The actual former, the larger piece, is shaped to the inside of the coping, but is made about $1\frac{1}{4}$ ins. longer. The length will then be a little over 8 ins., the width 6 3/16th ins., so that when the metal is hammered over it comes out at $6\frac{1}{4}$ ins. over the outside. The former is made of a piece of English maple $1\frac{1}{2}$ ins. thick, $\frac{3}{4}$ in. width of which is shaped as shown. The top is curved to a half circle of 3 3/32nd-in. radius from the upper centre, and is filed and sandpapered on edge all round to a radius of 9/32nd in. It is holed accurately on the lower centre ($\frac{1}{8}$ in. below the point from which the curve is struck) to take a 5/16th-in. bolt. An oak clamping piece $\frac{5}{8}$ in. thick and $4\frac{1}{4}$ ins. wide, curved at the top from same centre, and similarly holed $\frac{1}{8}$ in. below, is used to clamp the plate by means of a 5/16th-in. wing-nut and washer. The back half thickness of the actual former is cut down on edge clear of the front part, but is retained to give the former weight and body to resist the hammering. The finished edge of the former is not made square with the face, but is sloped down slightly, so that, on

hammering over, the metal springs back to about the right-angle bend.

The plate used is about 7 11/16th ins. wide by about $8\frac{7}{8}$ ins. high, and is holed for the bolt in such position that when clamped to the former it projects $\frac{3}{4}$ in. all round from its edge as shown dotted. It is clamped between the front face of former and the oak clamping block, and Mr. Willoughby describes the hammering as having been done while he was sitting and holding the job on his knee.

A well-balanced hammer, from $\frac{1}{2}$ to $\frac{3}{4}$ lb. head, was used, and only the flat pane employed. The hammering is started at the top and carried gradually both ways down the curve, a little at a time, the straight portions being bent over to

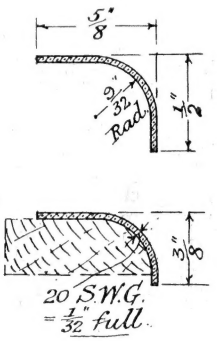


Fig. 2.—Finished Cross Sections at Top and Wings.

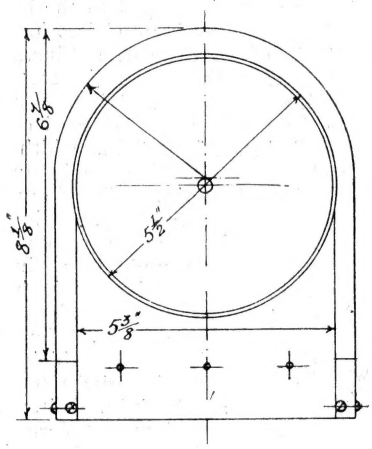
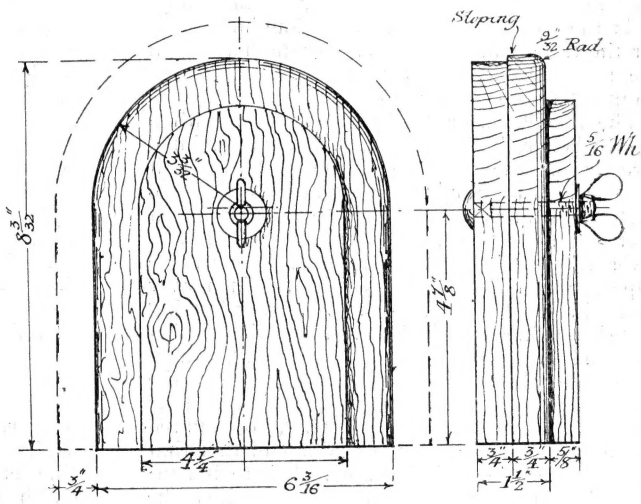


Fig. 4.—Showing how the Superfluous Metal between was removed.

When hammered over all round, it was shaped as shown in Fig. 4, and in order to cut away the centre portion three small screws were fitted, approximately in the positions drawn, by means of which it was screwed to the former with three small round-head wood screws, the clamp and bolt and wing-nut being removed. By means of a washer cutter, fitted with a parting cutter set to $5\frac{1}{2}$ ins. diameter, and working at the bolt centre, the disc forming the half circular curved inner edge was cut right out. Next it was marked with side lines $5\frac{3}{8}$ ins. apart, equally about the vertical centre, and the throat-piece sawn out, using piercing saws run along these lines. These edges are 1/16th in. too wide, and are filed down to the $\frac{3}{8}$ in. width, to carry out



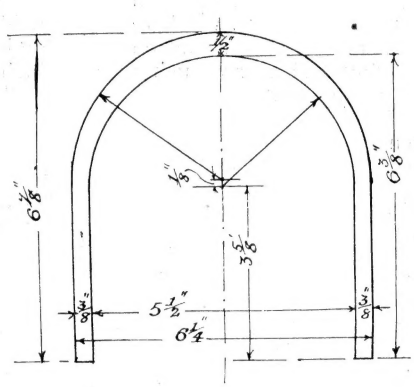


Fig. 3.—Detail of Former and Dimensions of Finished Coping

the angle thus far carried, by hand. It will be seen that the mean half circumference of the portion to be bent over is much more than its length will be when bent over, and therefore, unless done gradually, the metal tends to cockle, and so soon as the material becomes refractory, due to work hardening, the plate is taken off and annealed by making it a good red heat and plunging into cold water. It is understood that this annealing was done quite forty times during the process of hammering over. It will therefore be seen that it is quite impossible to bend the plate right over at any one point, and to go on from that. It must be done gradually, annealing between whiles, to admit of the material spreading outward and thus accommodating itself to its condensed dimensions.

which, a piece of oak shaped as shown dotted section in the lower of the two cross-sections in Fig. 2, was cut and rounded on edge corner to fit the inside radius of the shaped coping along the straight part. A piece about 4 ins. long was made, and with it each wing was held in vice jaws without deforming the job, and thus filed to the $5\frac{1}{2}$ ins. inside width.

When this was finished the job was put back on the former, cut to peripheral width, and fitted with two small wood screws on each side down at the bottom, as seen in Fig. 4. Thus set up, it was draw-filed and polished all over the outer surface, and was afterward sawn to length of $6\frac{7}{8}$ ins., as indicated, leaving the extra $1\frac{1}{4}$ ins. of wings on the former.

The edges of the peripheral sides were filed to

butt to the lagging plates and a little fitting was required to ensure the job conforming all round.

As thus finished, it is as seen in Fig. 1, and constitutes a job in hammered plate work worth emulating, because it is about the only way a single example of such a coping could be produced. Of course, to shape it rapidly could be accomplished with a fairly simple press-tool, but this would only be a proposition where numbers were required.

The material used was No. 20 S.W.G. rolled brass plate, of sufficiently good quality to stand the operation without cracking anywhere at the hammered bend, and sufficiently good to stand repeated annealing without getting brittle and rotten from the heating.

University Students Build a Locomotive.

THE locomotive shown in the accompanying illustrations was recently built by the engineering students of the University of North Dakota as part of their course in workshop practice. It is 16 ft. 5 ins. in length overall, and from the track level to the funnel top is 3 ft. $2\frac{1}{2}$ ins. It is approximately one-fifth scale of the prototype. The gauge is $12\frac{3}{4}$ ins.; and the total weight of engine and tender is 4,090 lbs. The boiler has seventy-six tubes, the grate area is 405 sq. ins., and the heating surface 11 sq. ft. The firebox measures 23 ins. in length, with a height of $15\frac{1}{2}$ ins. in front and $14\frac{1}{2}$ ins. at the back. The widths of the firebox are top front $14\frac{1}{2}$ ins., top back $14\frac{1}{2}$ ins., and 18 ins. at the bottom. The tender will hold 676 gallons of water and 162 lbs. of coal.

Mr. A. W. Preston, the Assistant Professor of Mechanical Engineering, who has kindly furnished us with the above details, writes as follows:—

"As I stood at our railway station one day looking at a locomotive, the thought came to me that a model built by students would be fine training and a very interesting problem in shop-work and design, and therefore I started to make a few drawings. Having finished the design of the cylinders and frames, and receiving a number of compliments, I continued to draw other parts. This required considerable extra time, but the work was enjoyable. After having a sufficient number of parts drawn which would give me an idea of what the completed job would look like, we started to make the parts.

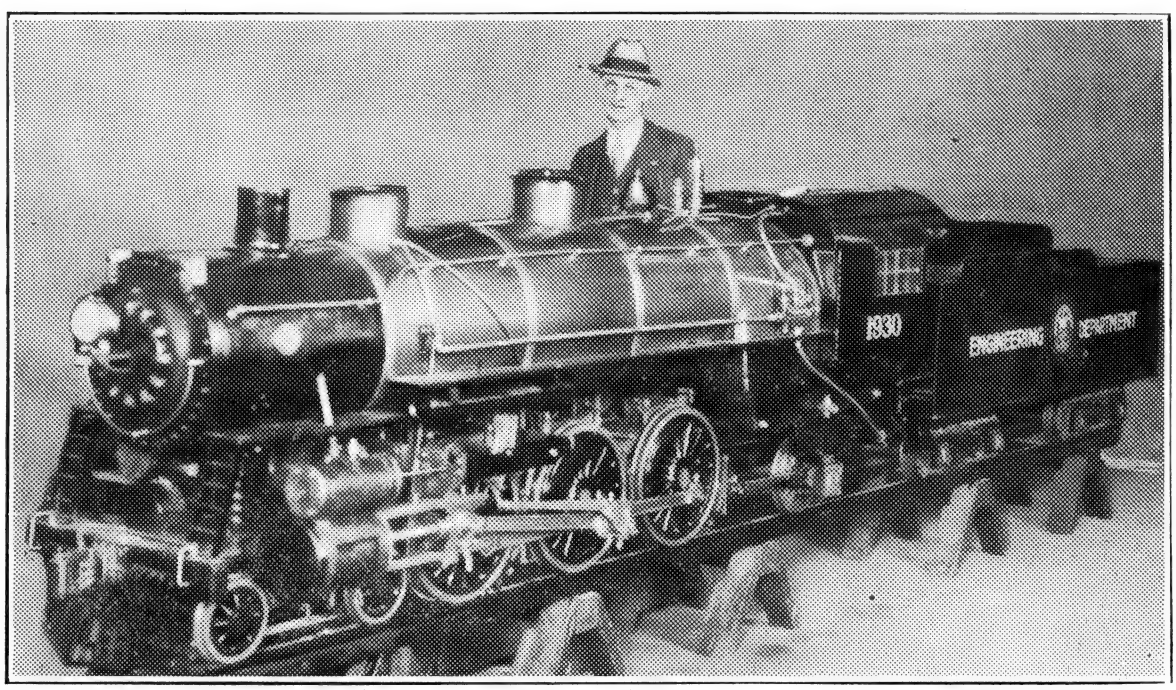
"First our classes in pattern-making were given the job of making wood patterns for the cylinders, wheels, boxes, and many other parts. Next the foundry class was required to make the castings, many more than we actually required. This work in casting gave them experience both in cast iron and bronze.

"The work was not all done by one class; it required three years to complete the work. One interesting point is that my present classes are sorry the engine is finished.

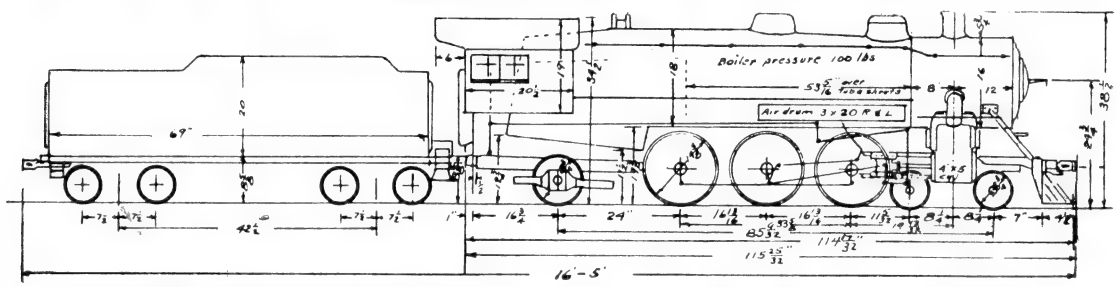
"Our next job was to machine the castings as well as machine a large number of steel parts and bolts. All of the bolts and cap screws were made on our turret lathe—780 bolts in all.

"We purchased $\frac{1}{8}$-in. by 1-in. flat spring steel and made all of the springs, fourteen in all. This work, as well as various frame braces and angles, was some nice work for our forging students.

"I also have classes in oxy-acetylene welding—our boiler has all welded seams, not a rivet in the boiler or firebox. The tank and cab is



The Completed Locomotive built by Students of the University of North Dakota.



Outline Side Elevation of Locomotive, built to a scale of approximately 1/5th full size of Prototype.

also a welding job. All of the engine wheels have steel tyres, the wheel centres are of cast iron. The locomotive is approximately one-fifth of the size of a large engine of this type. We expect to conduct some experiments on this engine, but I suppose later it will be placed in one of the city parks."

Altogether it is a very fine piece of work, and we are glad of the opportunity of presenting it to our readers. Not only has work of this kind a very marked all-round educational value, but it gives the students an exceptional interest and zest in their work. As Professor Preston points out, they are sorry that the engine is finished.

Belts for the Small Plant.

By W. E. Warner.

IN every small plant, model engineer's workshop, garage, electrical installation, etc., there are one or more belt drives for transmitting power from a driving to a driven shaft. To many engineers a belt is a belt simply to transmit power between two pulleys and is not an engineering consideration. This is not the case. There are many kinds of belts, and if any belt is going to have its maximum life, be free from those troubles such as slip, belt flap, and frequent breakage, the belt must be carefully chosen and attended to when in use.

Belts in common use are leather belts, cotton or canvas belts, balata and similar composition belts and rubber and rubber-faced belts. Leather belts can be again subdivided into ordinary oak tanned belts, those stitched with raw hide, laminated leather belts, chrome leather, raw hide belts.

The above shows there is a wide choice of belts, which will enable all conditions to be met. Leather belts are the most durable and most largely used for heavy power work, rubber belts are suitable in damp situations, and composition belts are made of various types and grades as substitutes for leather belts or to be used where they would be unsuitable.

Now assuming the correct type of belt has been chosen, the driving and driven pulleys in exact alignment with one another, the belt can be put in position. Belts drive best when slack and when the belt makes as great an arc of contact round the pulley as possible; this greatly reduces the pull on the two shafts and reduces the strain on the belt. When a belt is run very tight it exerts a considerable pull on the two shafts, this causes the bearings to heat and wear; there is a considerable power loss and a much greater wear on the belt.

If the belt is too slack, it will slip, this will cause a power loss, a loss of speed, continued slipping seriously damaging a belt.

However, a belt should always be run as slack as possible, short of the point where slipping commences. When a belt is first placed on the pulleys it should be just tight enough to drive, as it continues in service it will stretch and this stretch should be taken up from time to time as is found necessary in order to prevent slipping.

The use of a suitable belt dressing is also advisable. When a belt is made a certain amount of lubricant is impregnated into the material, in course of time this drives out when the belt is in service. A certain amount of lubricant is necessary in any belt which is to work properly and have its maximum life, a certain amount of internal friction takes place within a belt owing to the stretch of the fibres as it passes round the pulleys. It is to reduce this friction and to preserve the belt that a dressing is used.

The requirements in a good belt dressing are: that it should have no harmful effect on the belt, that it should preserve it, and that it should pass right through the belt so as to make it supple and flexible. The real object of a dressing is not to make a belt grip its pulley better, but to keep it supple and flexible so that it will wrap round the pulley. Many belt dressings are practically useless as they only act on the face of the belt, to be effective any dressing must penetrate from the face to the back so that it will completely lubricate it. I have found cling surface dressing excellent for preserving and enabling belts to run slack.

Before applying any dressing, a belt should be thoroughly cleaned, otherwise the dressing cannot penetrate. This can be done by brushing the face of the belt with a wire or bristle brush, and wiping it with a cloth moistened with paraffin oil.

If possible, prevent oil getting on a belt, but if by any chance a belt gets oil soaked the best treatment is to apply some powdered chalk to its inner face while running. This should be done just before stopping. The belt should be allowed to remain for a few hours and then the chalk scraped off. The chalk will absorb the oil and one or two treatments will completely remove all the oil. Belts should always be jointed carefully, always use a set-square when cutting a belt and see that the fastener used is of the correct size and type, that it is fixed square and well hammered down.

Petrol Engine Topics.

By Edgar T. Westbury.

Crankshaft Design.

ONE of my friends who has made a very efficient four-stroke job has lately had a large "spot of bother" with crankshafts. In view of the very high loading, the design of the shaft, and also the crankcase, was open to some criticism, but the engine ran without trouble until it had been through a "hotting-up" process prior to a big regatta last year, and then, at the moment it was called upon to "do its stuff," it served its owner a very dirty trick by breaking across the eye of the web, and destroying his otherwise fine chance of winning the race. A second crankshaft was built up by welding (the first was brazed) but ran for only ten minutes before the welded joint gave way. At the time of writing a third shaft is under construction.

I do not approve of brazed crankshafts for petrol engines, not because of the lack of strength of a good brazed joint, but because it is almost impossible to ascertain to what extent the brazing has penetrated the joint and properly alloyed with the surfaces (a brazed joint tested to destruction nearly always shows some evidence of faulty adhesion), and also because the spelter loses its strength by fatigue much more rapidly than is desirable in structures subject to vibration. Welding, if properly carried out (in the case in question it wasn't), is not subject to this objection, but one nearly as serious is the alteration in the properties of the steel which may be caused by the intense heat of the welding torch or arc. In fact, certain steels which are very suitable for crankshafts cannot safely be welded at all.

This appears to leave us with only two alternatives: cutting the shaft from the solid (or a solid forging) or building up by clamping, bolting, shrinking or riveting. Either of these methods will, with careful workmanship and sound structural design, result in a shaft which will stand up to any fair wear and tear.

But often any weakness in the shaft is badly accentuated by the way it is supported in its bearings. It was so in the case mentioned above. Apart from such considerations as the rigidity of the crankcase, it is most important that the main bearings should be as close to the webs as possible, to avoid the possibility of deflection of the shaft under explosion load. The shape of a crank is such as to ill adapt it to resisting a heavy load in the centre, if only supported at the extreme ends. This engine had the timing pinion between the web and the bearing, and I am of the opinion that this was the real reason for its collapse.

Air *versus* Water Cooling.

In view of the fact that of recent years I have been a strong advocate of air cooling, I am sometimes accused of putting novices on the wrong track by advising them to use it instead of the more positive method of water cooling. My own policy of advising the beginner to take on something which he can tackle with fair chances of success seems to be coming back at me here, I am afraid, but I have several reasons for preferring air cooling. The first and obvious reason is its simplicity; a water pump is not always the simple thing it should be, and water joints are not immune from trouble. Water-cooled boat engines are not uncommonly seized up by tuning up on the bank with no water available. Secondly, it is extremely difficult to ensure that the water calculation is suitably regulated, and many engines are definitely over-cooled, which seriously affects combustion and lowers their efficiency. But the third and really important reason is that, by relying on air for cooling one has a valuable check on engine efficiency. The very fact that air-cooled engines sometimes overheat is, in itself, a proof that water-cooled engines are sometimes cooled by brute force!

If it were impossible, or very difficult to secure adequate cooling by air alone, it would be very bad policy to advise its use by beginners, but I find that there is no difficulty at all; in fact, over-cooling is quite possible. Assuming that both the cylinder and head are moderately well finned, that the latter is shaped to permit of heat being conducted away from the hot spots, and that plenty of metal is allowed at the joint to help heat conduction, a tendency to overheat denotes that all is not well inside the engine. It may be that the valve timing is capable of improvement; that hot gas is leaking past the piston; or that combustion is not efficient. It is not perhaps obvious, but none the less a fact, that an engine which is using the calorific power of its fuel efficiently inside the cylinder has comparatively little to spare for blueing up the exhaust pipe! With a water-cooled engine the absence of obvious symptoms may delude one into the belief that everything is O.K., whereas actually the engine may be very definitely below par.

There are, undoubtedly, conditions existing on larger engines which often make water cooling very desirable, if not absolutely necessary, but I do not think they occur in model engines. Water cooling may be a very safe policy, but "safety first," although an excellent policy in some matters, is not altogether a progressive one in engineering. Surely it is better to track losses in efficiency to their very source and eliminate their causes, than to cloak them, labouring under the delusion that "no evidence of existence is evidence of non-existence." Even with very little air current, a model petrol engine should keep cool at half load at least, and with a gentle draught of air it should take full load without distress. Incidentally, I have known engines which overheated when a trembler coil was used for ignition completely cured by changing over to a non-trembler coil or magneto.

The Scott motor-cycle is often quoted to me as an example of the advantages of water cooling, but while allowing that there may be some-

thing in the argument for engines this size, there is no evidence that the same performance is not attainable by using air cooling. I cannot help but think that although possibly the advantages may be very definite, the makers of the Scott engine might have learnt far more about that type of engine by relying on air cooling (they have recently introduced an air-cooled engine, by the way)—which remark calls for the obvious retort that this and other firms are not in business solely to develop engine design, but to make a profit! And there, dear reader, is where the model engineer has a chance to come in. *Think it over!*

Precision and "Jazz" Tools?

A SCREW-DRIVER made out of a piece of steel driven into a holly stock cut out of a hedge, provided it is properly tempered and the right shape, will drive a screw as well as one of those automatic American tools costing 7s. 6d., and for the average mechanic the former is quite as satisfactory.

Where a man is engaged on the wholesale assembly of some trade production where his whole job from morning to night is pushing in screws, there is no comparison between the two, the automatic scores every time.

Now a tool merchant, catering mainly for amateur mechanics, has to consider whether it is worth his while to stock the 7s. 6d. article, when a tool which will do the work equally well can be bought for a few pence.

Utility is not the only point of view he has to study, however. The amateur mechanic is a complex animal! He is probably quite aware at the back of his mind that the cheap tool is all he wants to do his job. He sees this American gadget with its neat mechanical devices, which appeal to him, and then he thinks of "that job he had two years ago when he had to screw in two gross of screws—yes, he might get another job like that. How sick he had been and what a blister he had on his hand. Yes, he would have the 7s. 6d. American gadget."

The next man coming in thinks, "Yes, that is quite nice. I think it would be a great convenience. I would like to have it, but if I blow all that money on a screw-driver I shan't have enough money to buy a new valve for my set and I want that badly, as the one I have is quite dud—I'll have a cheap one and wait for better times."

Probably there will be many more shillings taken by the vendor for the cheap article than the more expensive item.

He must go on stocking the American article, however, as he will certainly sell some of these, and he can rest assured that the sale of the expensive tool will not prevent the sales of other tools in the shop.

If a man wants several tools he has a list and gets them. Probably he has looked up the prices in a catalogue, and has made sure that he has enough money in his pocket to pay for them before he enters the shop. This man might be tempted to buy the more expensive American article if he has the spare cash in his pocket.

Now much the same applies to lathes and the like. The psychology is much the same on a larger scale. One firm may make precision lathes which cost between £50 and £250, according to the number of appliances, oval and geometric chucks, overhead motion, etc.; another firm may sell a lathe for, say 30s. Both can be used for turning and there the semblance ends. In the hands of an expert the works of a clock can be turned out down to the finest detail with an accuracy requiring Johansen gauges to detect errors on the first, whilst the cheap lathe will turn out things which may appear to be round but will measure several "thous." out on different diameters.

Now an instrument-maker would be lost without his precision lathe, but the novice would be equally lost with it!

Let the novice start with the cheap lathe. If he "catches a crab," no serious damage will be done (30s. at the most), but if he has an accident with the precision tool it will be a precision tool no longer.

When he can get the best out of a cheap lathe, let him try a precision tool, he will then know what snags to look out for.

If he has room in his workshop let him still keep the cheap one for "hack" work; there are plenty of jobs going for which it can be used probably as efficiently as the better tool.

Now the merchant must stock both these lathes, as no amount of salesmanship will enable him to dispose of one of these if the other is required, although, again, he will possibly sell many more pounds worth of the cheaper article.

To go back again to the novice's point of view. Just as much fun can be got out of the cheap lathe as can be obtained from the precision lathe, in fact, generally much more!

After he (the novice) has overcome the first difficulties, he will find probably that the mandrel is right out of alignment with the dead centre and *vice versa*. Let him set to work and line them up truly.

Then the mandrel will probably be found to be doing a sort of jig or Highland fling inside its bearings. The mandrel may or may not be round and straight! Let him set to work and amend these little errors; it is wonderful what can be done with patience, ingenuity, white-metal, a hammer, file and a scraper, with perhaps a visit or two to the local junk shop.

Then with the cheaper lathe improved, set to work and make an astronomical clock correct to two seconds per week, month or year! The mechanic who has done this with a 30s. lathe ought to feel himself much more bucked than he who spent hundreds of pounds on his tools.

A well-known writer in THE MODEL ENGINEER made a lathe on which he turned oval photo frames at a total cost of 6d. and many hours work. Perhaps he will see this and let us have a schedule of costs and time-sheet!

The PRACTICAL ELECTRICIAN
LIGHTING · POWER · MAINTENANCE · REPAIRS

Modern Electrical Installation Work.

By Frederic H. Taylor, A.M.Inst.E.E., A.M.Inst.M.E.

(*Continued from page* 154.)

Earth Plates.

THESE should in most cases be of copper and of size, say not less than 2 ft. by 2 ft. by $\frac{1}{8}$ in. thick. Where such plates have to be buried in the ground in order to form the earth connection, they should be placed vertical and at sufficient depth below the surface to be always in a moist soil.

In certain places a *copper* plate is not desirable, as, for instance, in the neighbourhood of tar distilleries, ammonia works or creosoting works. Here, copper is readily attacked and corroded, and an *iron* plate would be much better. Extra surface should, of course, be provided, and for this purpose old chequer plates, or firebars, galvanised iron sheets, etc., form an excellent substitute, provided proper care be taken in connecting them up.

Never use as an earthing connection: gas pipes, hot-water pipes, iron soil pipes, etc., nor yet even a lightning conductor. None of these are reliable.

Connections to Pipes, etc.

Any connection to a pipe, whether this be an electrical conduit or a water main should be done by means of a proper clamp. Many patterns are on the market, but they are by no means all of them efficient. The best and simplest is that shown in Fig. 8. This consists of two half clamps bolted together and made either of wrought iron or copper and of a size which gives a good area of contact, metal to metal. The contact surfaces of the pipes and the clamps must, of course, be made quite clean by scraping or filing. For connection between the clip and the earthing wire a sweating socket should be used wherever possible, and in any case for any earthing conductor of section .007 sq. in. (7/.036 in.) or larger, this being stipulated by the Regulations of the Institution of Electrical Engineers.

Simple Pipe Clamp.

Earthing Terminals.

All domestic or industrial appliances, whether portable or fixed, such as electric irons, bar fires, cookers, portable tools, etc., are provided with an earthing terminal, which usually consists of a cheese-headed screw and washer, this being essential under I.E.E. Regulations.

Tests of Earthing.

It is essential that the earthing in every installation should be tested on completion. Frequently an ordinary bell and battery test is made. This, however, is not of itself sufficient, as it merely indicates "continuity" or otherwise. This point will, however, be fully dealt with in a subsequent article covering all testing work as required by the installation man.

Non-Metal Cased Wiring Systems.

Within recent years various systems of wiring have been devised which come within this title. The principle of them all is that the conductors as used shall be sufficiently protected by their own insulating covering that they do not require further protection in the form of a steel conduit or other metallic sheathing.

Amongst the well-known systems of this kind may be mentioned:—

The C.T.S. (St. Helens Cable Co.).
"Maconite" (Macintosh Cable Co.).
"Nomet" (W. T. Henley's Telegraph Works Co.).

In each case the conductors consist of the usual high conductivity tinned copper wires insulated with pure and with vulcanised rubber and then sheathed overall with "cab-tyre" rubber. This latter material, known under the trade name of "C.T.S." or "Cab-Tyre Sheath," is a specially tough rubber composition, obviously waterproof and one which will withstand fairly rough usage. It is said to be very proof against corrosion and to be non-kinking.

Some manufacturers make these conductors without pure rubber insulation, relying entirely on the vulcanised rubber. In this case the V.I.R. is specially graded so that its effect on the tinned copper conductor shall be practically negligible.

The conductors are fixed to the wall or other surface by means of metal clips as used in a lead-covered system or by small short pieces of strip lead about $\frac{3}{8}$ in. wide.

Joints are made in connector boxes made of ordinary moulded insulation. Ordinary fittings and accessories, such as wood blocks, ceiling roses, switches, etc., can be used with any of these C.T.S. systems. Cheapness in first cost is, of course, the great point in their favour.

Wood Casing.

This system is commonly regarded as a thing of the past. Many old installations carried out in wood casing are, however, still operating satisfactorily, and when used in dry positions, on the surface, the system maintains its insulation well.

The Choice of a System of Wiring.

In a previous article it was stated that "no one system can be said to be always the best in any case." This point therefore calls for very careful judgment on the part of the engineer who is responsible for the work, a judgment which can only be founded on experience coupled with knowledge and training. Apart from ordinary simple jobs of no great size and where no special circumstances exist, the engineer has to consider carefully such points as fire risks, permanence of insulation, corrosion and low maintenance costs of the installation. Certain differences may be necessary according to whether the installation is for lighting, for heating or for power. The question of the first cost of the installation will also come in for consideration, but must not be regarded as the main point. In new buildings wired during erection and in many buildings wired after, the difference in first cost between a good-class conduit job in screwed welded conduit and a good-class job in lead-covered wiring is practically negligible, so that in making a decision between these two the circumstances and conditions of the case must be the basis of settlement. There are, of course, many positions which always call for special treatment either as regards the actual wiring or the accessories and fittings used, if successful working is to be assured. Amongst these may be included such places as: conservatories, bakehouses, public wash-houses and lavatories, stables, etc., churches and ancient buildings, etc.

Making a Start on the Job.

Having selected the most suitable system of wiring for his job, the installation man will next proceed to put in his conduit or maybe the lead-covered conductors, whichever may have been selected. These two are merely taken as typical instances.

He will first require to select the positions for the distribution boards or fuse boards, as they are sometimes called. This will enable him to settle the "runs" from the lamp points and the switch points back to these. It will also enable him to settle the runs from the distribution boards back to the position where the electricity supply enters the premises. Having settled these two points, the next step will be the cutting through of the floors and ceilings, and maybe the walls also, so that the conduits or the lead-covered cables (according to whichever system be chosen), may be got into position, and here is the installation man's chance to show that he understands this very essential though non-electrical part of his job. Electricians are very frequently blamed for their lack of skill in this part of their work, and the injury which then results to decorations and sometimes even the structural parts of a finished building. A few brief notes will therefore follow.

(To be continued.)

Electrical Questions and Answers.

(Mainly Selected from Recent City and Guilds Examination Papers.)

28. Q.—Discuss briefly the relative advantages and disadvantages of the following systems of wiring: slip-socket conduit, screwed conduit, and metal-cased wiring such as lead covered.

A.—Slip-Socket.—This is not watertight, it cannot be bent or set unless a welded or a brazed conduit is used, and continuity grip fittings must be provided in order to provide electrical and mechanical continuity of the system. It is, however, a cheap system to instal.

Screwed Conduit.—This provides the best mechanical protection to the conductors, and is readily installed as a water-tight system. The conduit is easily bent or set as required, and it can be used on the surface or concealed under the plaster, as desired. Good continuity is easily obtained without special fittings.

Metal-Cased Wiring.—Ordinary lead-covered wiring is not water-tight, though the system can be made so by the use of special fittings. It is preferably not used under plaster work, unless protected. Its cost when carefully carried out is not much less than that of a screwed system.

29. Q.—Is there any objection to using steel conduit or piping on an installation supplied with alternating current, and does it matter how many conductors are run in one pipe?

A.—No, provided always that conductors of opposite polarity are bunched together in the same conduit. It follows, therefore, that not less than two conductors may be run in one pipe, but the total number will be determined by its internal diameter, for which purpose reference may be made to Table 12 of the Institution of Electrical Engineers' Regulations for the Electrical Equipment of Buildings. It is essential, of course, the piping or conduit be made electrically and mechanically continuous and efficiently earthed.

30. Q.—In connection with a screwed piping installation, the distribution boxes supplied are of hard wood. What method would you adopt to maintain continuity of the pipework?

A.—Assuming that the pipes carrying the conductors to the circuits leave the distribution box by the top of it and that the incoming feeders enter the box from a pipe at the bottom, it will be necessary to bond together the pipes at the top, say by means of a clip formed of two pieces or strips of copper, and to then connect this by a copper bonding wire to a clip on the incoming pipe at the bottom. Care must be taken to see that this bonding wire is kept well clear of the conducting metal work of the distribution box.

The "Model Engineer" "1500" Three-Valve Receiving Set.

By H. J. Barton Chapple,
Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

(*Continued from page* 159.)

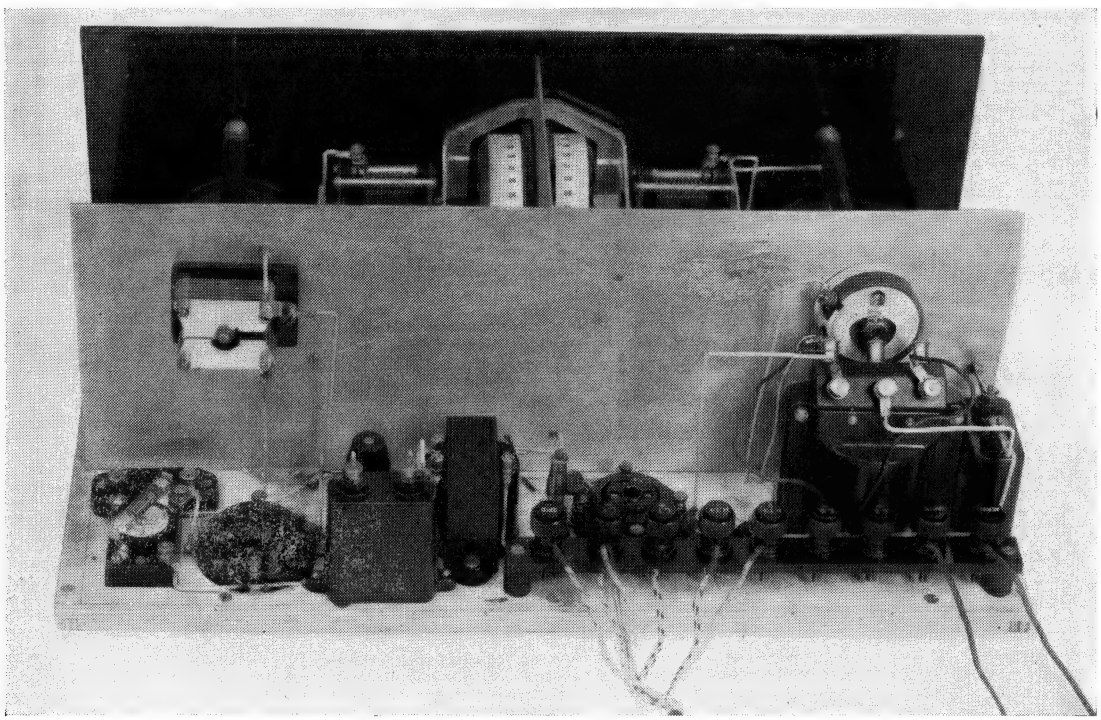
NOW that you have got an impression of what the set looks like from last week's instalment and learnt some of its capabilities, we must complete our consideration of the theoretical diagram so as to proceed with the constructional details. In the high-frequency stage you will notice that both the plate and screened-grid connections to H.T.+2 are "decoupled." That is to say, the resistance of 20,000 ohms together with the 1 mfd. fixed condenser joined to earth, when connected up in the manner shown, will ensure stability in working. In addition, the correct screened-grid voltage will be applied as a result of the drop in voltage across the 20,000 ohms.

The same argument holds with the combination of the small 600 ohm resistance and 2 mfd. condenser, and on no account should they be omitted. In the reaction circuit it might be assumed that hand-capacity effects will be present owing to the moving plates of the differential reaction condenser not being joined to earth but to the plate of the detector valve. By hand capacity effects we mean the capacity alteration brought about by the approach of the hand to the control knob and the possibility of the set bursting into oscillation or being erratic in operation every time this control is worked. You will see from the photographs, however, that by using an extension handle and mounting the condenser some distance away from the front panel we have overcome this possible defect.

Making a Start.

Now I want you to pay particular attention to all the constructional details of this receiver and carry out the work in the order named as this will ensure that mistakes are avoided. First of all, take your panel and mark it out carefully on the back with a steel rule and sharp-pointed scriber. The full details are given in the panel layout diagram, and since it is perfectly symmetrical there should be no difficulty in performing this work. Be careful not to force the drill through as it is just emerging from the panel face when drilling operations are in progress, otherwise you are liable to be left with a jagged-edged hole.

A template is supplied with the Lotus drum dial condensers, and this may be used to mark out the holes for cutting away the centre portion of the panel. The six holes at the bottom of the panel are for the wood screws holding it to the baseboard and should be countersunk just sufficient to allow the screw heads to be flush with the panel face.



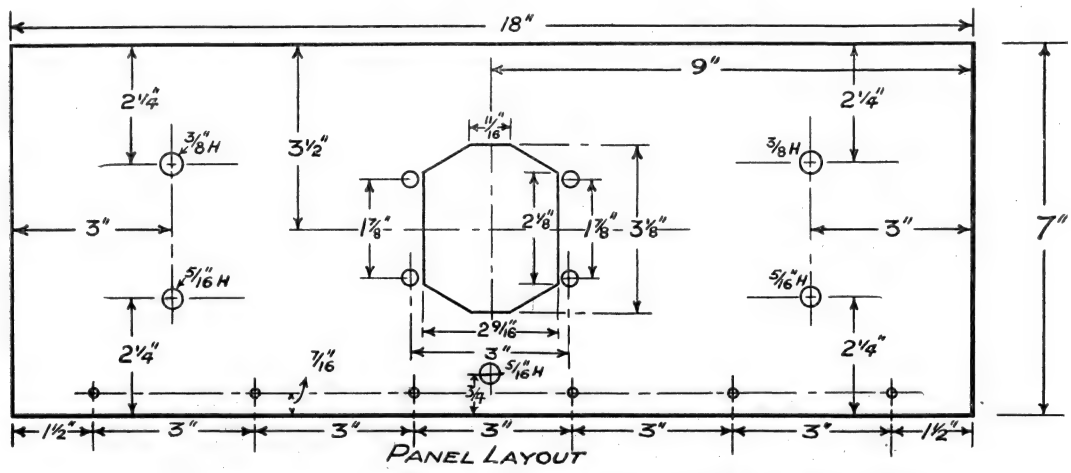
View showing the Low Frequency Side of the "M.E." "1500" Set.

Mounting Panel Components.

When this is completed refer to the back of panel wiring diagram and the photographs and see exactly how the components are arranged on the panel. Mount the drum dial and pair of condensers first but before doing so take off the metal washers holding the condensers to the drum frame and replace with the insulating washers which are supplied with the condensers. See that the condensers are held firmly in place and are in line and allow the milled drives to project sufficiently so that the thumb can move them round easily.

Now cut off a small segment from the bottom of each multi-coil ebonite base-plate—see the back of panel wiring diagram. This is necessary to allow the coil base to clear the baseboard. The type A coil is mounted on the right of the panel looked at from the back and the type C coil, on the left. This will enable you to cut away the ebonite base-plate at just the right position—diametrically opposite the No. 2 terminal in the case of the A coil and diametrically opposite the No. 1 terminal in the case of the C coil. Each of these coils may now be mounted on the panel and also the push-pull switch.

Do not worry about the two $\frac{3}{8}$-in. holes in the panel immediately above each multi-coil as these are for the metal bushes of the extension handles and we shall come to that later. The panel may now be laid on one side and attention turned to the metal screen.



The Dimensions and Hole Sizes for Marking out and Drilling the Ebonite Panel.

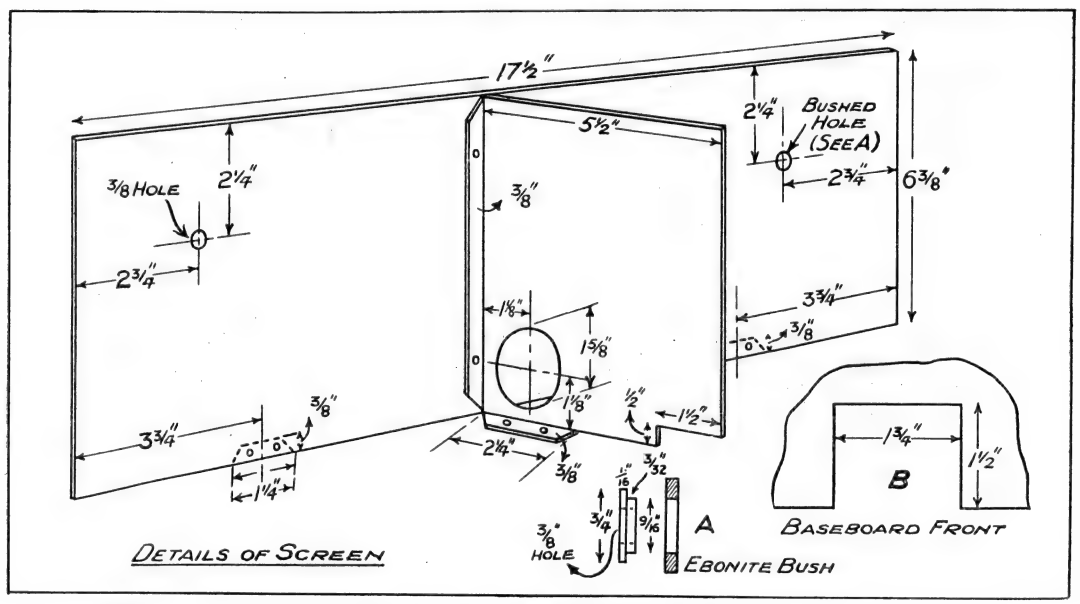


Diagram showing Complete Screen Details together with Ebonite Bush Size, and the Dimensions for the Hole cut in the Front of the Baseboard.

The Metal Screen.

Full dimensional details of this are given in one of the accompanying diagrams for the benefit of any reader who desires to make this up himself from aluminium 1/16th in. thick. On the other hand, arrangements have been made for Messrs. Burne-Jones & Co., Ltd., to supply the screen to anyone preferring to buy it ready made complete with the ebonite bush. This bush is for inserting in the hole marked "bushed hole," and details are given at A. It is at this point that we mount the differential reaction condenser and, of course, it is essential

"THE CHOICE OF CRITICS."

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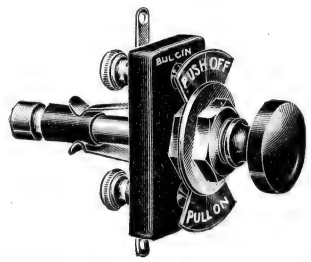

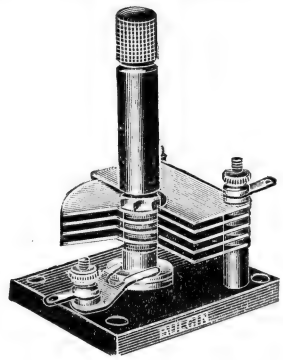

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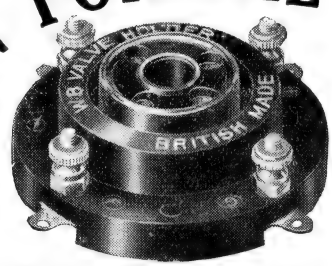

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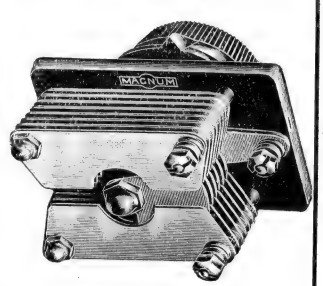

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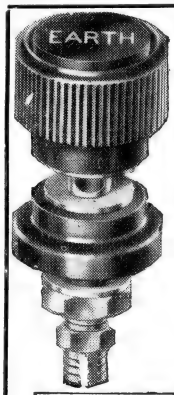

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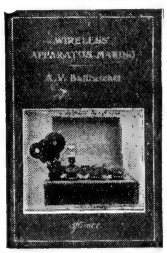

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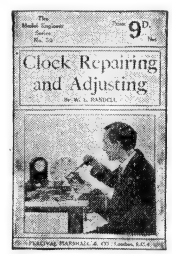
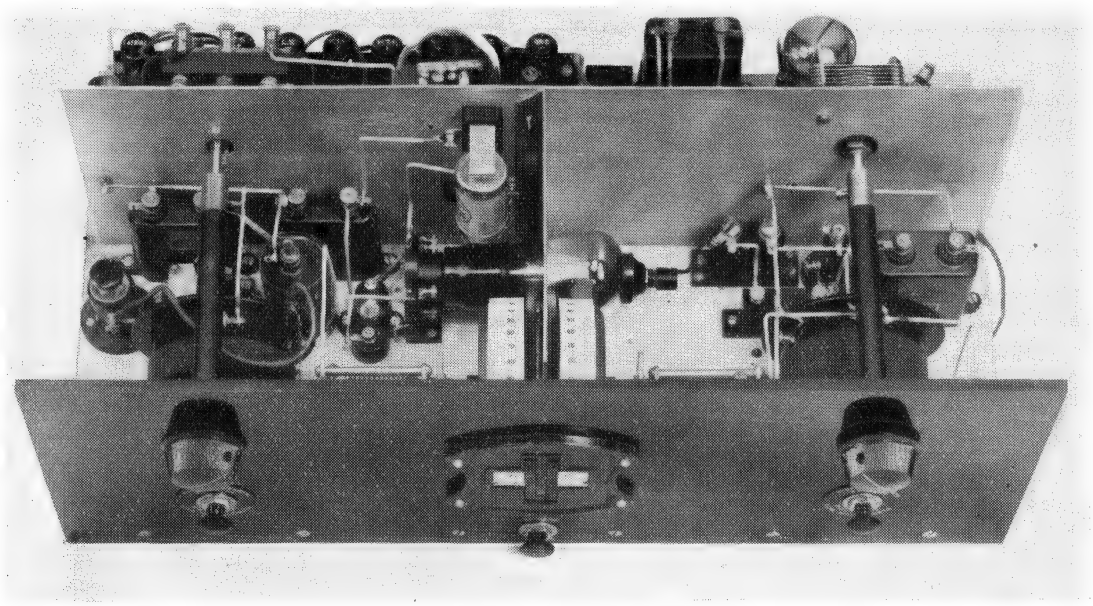


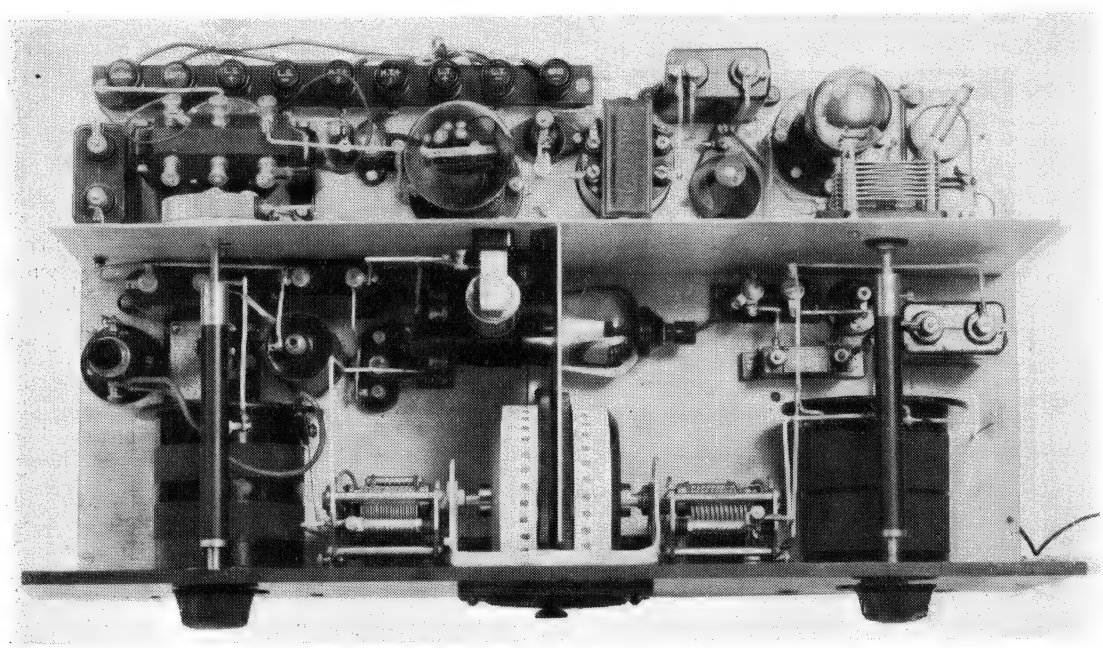


Showing how the Panel Controls appear; and note the Extension Drives for the Rheostat and Reaction Condenser.

to insulate it from the earthed metal screen. See that the feet used for holding the screen to the baseboard are positioned approximately as shown in the diagram as they will then nicely clear the baseboard components. It is essential that the two holes in the screen are accurately positioned as they must coincide with the panel holes and enable two extension handles to be fitted and thus manipulate the rheostat and differential reaction condenser from the front. Notice the small piece of screen cut away at the bottom part of the cross screen. This is necessary so that it will not foul the push-pull switch on the panel.

Screen Components.

To mount the rheostat you must drill two screw holes according to the template supplied with this component and this, of course, is quite a simple matter. In addition, the 20,000-ohm wire-wound resistance holder is mounted on the screen in the position shown in the wiring diagram and photographs, and it is easy to mark out your own two holes for this. The centre of the holder should be about 2 ins. down from the top of the screen and $1\frac{1}{8}$ ins. from the cross-screen. These one or two items will be made quite clear if the photographs are studied in conjunction with the wiring diagram.



Plan View of the Set which will help in Positioning the Components. Observe how the screened grid valve is placed.

There will have to be three other small holes drilled in the screen, but as these are merely for earth points in the wiring process, they are best left for the time being so that you can mark them out yourself. In any case, they are shown in the photographs and wiring diagram in case you should prefer to drill them beforehand. Having assembled the three components on the screen, not forgetting the insulating bush and washer for the reaction condenser, place the screen on one side and turn your attention to the baseboard.

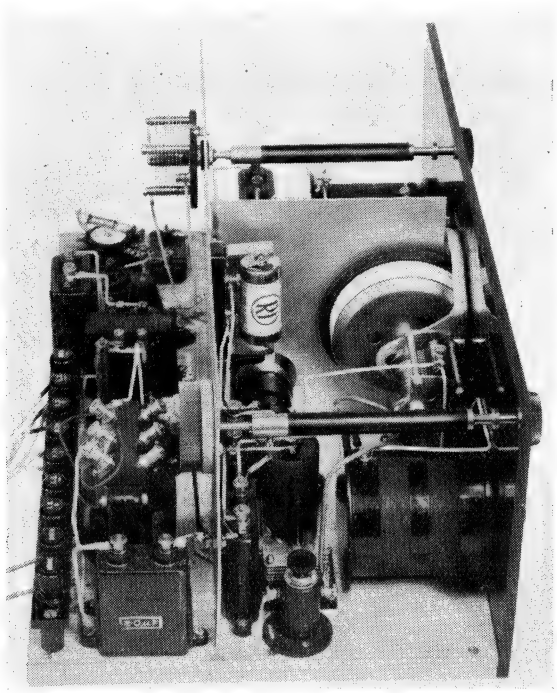
Using Battens.

The advantage of a full-sized blue-print will manifest itself here for the components have been laid out very carefully in order to reduce the length of the wiring runs to the barest minimum.

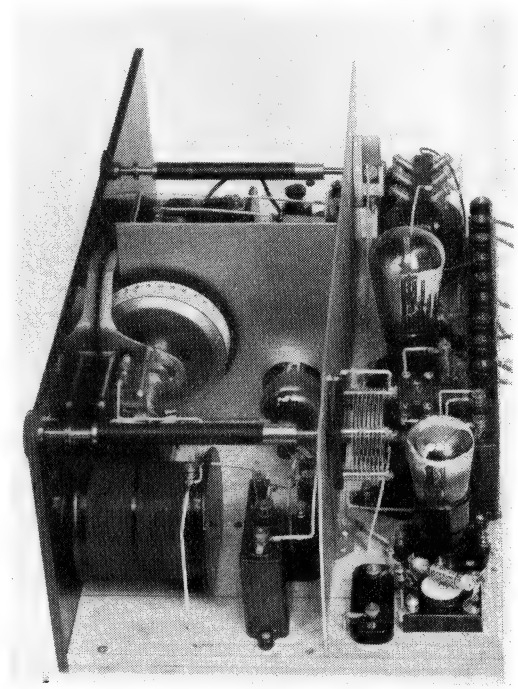
Since some of the wiring has been carried out under the baseboard, it is necessary to screw three pieces of wood $\frac{1}{4}$ in. by $\frac{3}{8}$ in. along two sides and the back of the baseboard to raise it a $\frac{1}{4}$ in. This will prevent the wires resting on the bottom of the cabinet. Also cut out a rectangular piece of wood $1\frac{3}{4}$ ins. by $1\frac{1}{2}$ ins. from the centre front of the baseboard—see B of the screen details diagram. This is to clear the push-pull switch. Note that it has been assumed that a baseboard $\frac{3}{8}$ in. thick is used, and this will be supplied by the cabinet-makers together with the cabinet. Before proceeding farther, the constructor is advised to put the baseboard and panel in position in the cabinet to ensure a gentle slide-in fit and secure proper alignment. Holes can then be made with a bradawl for the screw positions in the baseboard edge.

Careful Positioning.

Use the photographs in conjunction with the back of panel diagram to position every component, and it is a wise plan to place all the components on the board before screwing any of them down. This will enable you to make any slight adjustments should you find that any items foul. The nine terminals are mounted an inch apart on the terminal strip, and this strip is raised $\frac{3}{4}$ in. from the baseboard by two cylindrical ebonite distance-pieces through which pass the holding screws. One or two of the photographs will show what I mean, and notice also that the lettering on the terminals is arranged to face towards the panel. This is for easy observation when the set is in the cabinet and leads are being joined to their respective points.



View showing particularly the Aerial Side of the Receiver.



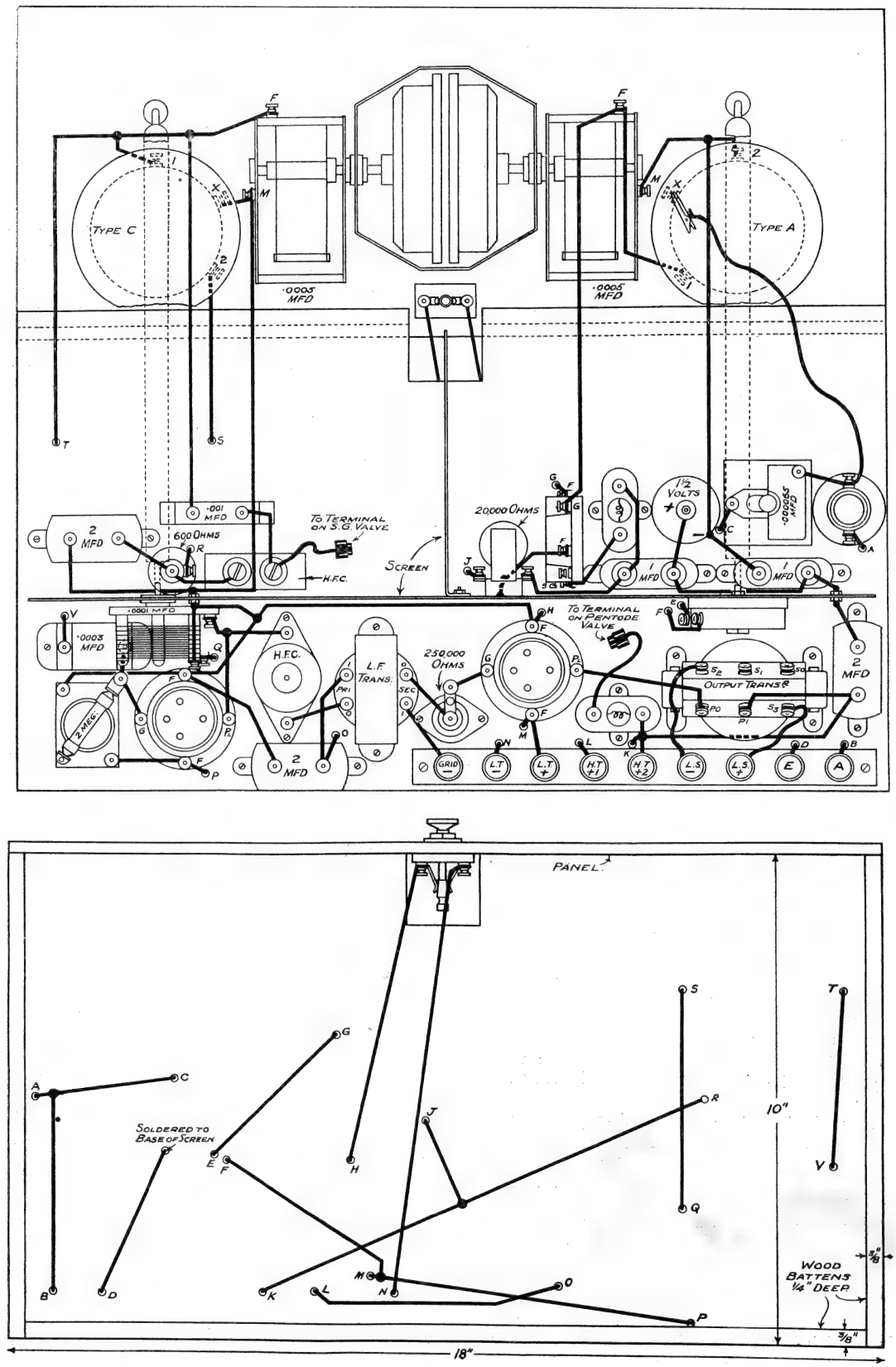
A Good View of the Second Screened Compartment showing the Screen Positioning, etc.

Do not attempt to put the screen into position yet. You will notice that there are several holes in the baseboard where connecting wires pass through for the under baseboard wiring. These holes are lettered A to V, and it is advisable to drill them before proceeding with the wiring.

Soldering.

The constructor can either make soldered connections throughout or he can loop the wires under the terminals, or, alternatively, have a mixture of both. As a general rule, it is best to make soldered joints on to soldering tags placed under the terminal heads. It is surprising how many people do not relish a soldering operation but really it is quite a simple matter. The secret lies in cleanliness. Do not overheat the iron and see that both the copper bit and each junction point or soldering tag is carefully tinned. When using the Glazite wire for connecting up remove carefully with a sharp knife sufficient of the insulating covering to make the soldered joint.

The several photographs will enable the constructor to visualise the runs of the wires and should be used in conjunction with the back of panel and above baseboard wiring diagram to



A BACK OF PANEL AND ABOVE AND BELOW BASEBOARD WIRING DIAGRAM.

Full size blue prints of these may be had from our Publishing Dept. price 1s. 6d. or post free 1s. 7d. per set.

ensure accuracy. Note that in the back of panel and above baseboard diagram the panel has been rebated down to simplify the indication of the wiring. The constructor can rely largely on his own discretion as to the order in which the wiring is undertaken, but the following hints may prove useful.

Wiring Hints.

Keep the wires as short and as straight as possible with neat right-angled bends where necessary. Execute first that wiring which is situated nearest to the baseboard. Remember that you must keep clear of the two control extension handles which pass from panel to screen. In the under baseboard wiring diagram the lettering on the holes corresponds to that on the above baseboard diagram, so that will simplify the process. Carry out as much wiring as possible before screwing the panel into position, and as each wiring run is done just *lightly crosshatch the wire in the diagram with a pencil.* This will serve as a check to ensure that a wire or wires are not left out.

Notice that the connections to the loud-speaker terminals are made in rubber-covered flex so as to allow the various secondary taps on the output transformer to be tried out in turn. There are a few wires which can be joined up to their respective points on the panel alone before it is screwed to the baseboard. The connections to the anode terminal on the screened-grid valve and the screen-grid terminal of the pentode valve are made via short lengths of rubber-covered flex, terminating in special Belling Lee insulating connectors.

Take Great Pains.

Remember also that the connection from the small variable condenser on the baseboard to the type A multi-coil is made with flex, a crocodile clip being used as a convenient means for changing the connection as desired when testing. Having undertaken the additional wiring with the panel in place, finally mount the screen and complete the remaining connections. One or two wires are joined to the screen as was mentioned previously and small screws and nuts with soldering tags are a good way to undertake this. The actual earth terminal is joined to a screw which passes through one of the screen feet to the underside of the baseboard. Whatever you do, avoid rushing this work of wiring up the set. The ultimate performance of a receiver depends to a very large extent on the efficient and workmanlike accomplishment of the wiring. We shall complete our story next week, when the operating details are dealt with.

(To be concluded.)

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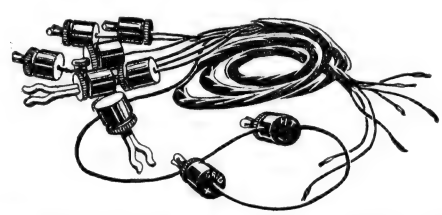

Seven-way Battery Cord. By Belling & Lee, Ltd.

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By "L.B.S.C."

How Fallacies Take Root and Grow.

I GUESS you all know how I love to chase a "theory-hound" when he airs his views on some subject or other connected with locomotives, and I happen to know from personal experience that he is absolutely wrong. However, there is nothing like giving 'em all a dose of the same medicine to cure the same complaint, so here goes for a tilt at a real railroad man who ran past a red light and got well off the track. He is an air-brake inspector who wrote a book on valve gears, and this is where he "leaked his brakes off."

The particular edition of the book in question was published in America in 1920, and is called "The Walschaerts Locomotive Valve Gear." It gives a very good description of the gear, and I was most interested in the copy a friend lent me, until I came to a chapter where the author deals with the question of lead. He says it isn't necessary, and gives as his reason that one night he was firing on an old 4—4—0 American engine when one side of motion gave out. He and his mate took down the damaged side, and proceeded to finish the journey on one cylinder only. By the usual cussedness of things that happen in this benighted world, the engine at the last stop naturally must needs go and pull up exactly on dead centre of the cylinder which was working. Of course, she wouldn't restart; so they loosened off the automatic coupler and left the safety chains on, hoping that if they moved the locomotive off dead centre with a pinchbar they could get her to haul on the safety chains sufficient to move the cars and get coupled again whilst moving. However, she wouldn't budge, despite the efforts of all the trainmen. At last, the engineer (driver) got down to lend a hand, telling the fireman (the author of the book) to open the throttle a bit as they pinched. Still nothing doing, so he shut the throttle and opened the cocks. Then she moved. He gave as the reason that the lead steam was jamming the piston out and locking the crosshead and big-end with excessive friction; and when he shut the throttle and opened the cocks it released the pressure. Therefore, argues he, lead is no good, it causes friction and ought to be abolished.

There's a Catch in it!

And a mighty big one, too—in fact, so big and so obvious that I am very much surprised that a railroad man, even if he is more familiar with air brakes than locomotive details, should fall slap into it. Let's analyse. When a Chinaman wants to tell you anything he usually broaches the subject of the weather, your health, the state of the family, etc., before coming down to brass tacks—"London Bridge to Cannon Street via Timbuctoo and Chicago" sort of business. Therefore, we will take a page from his book, and talk about automobiles.

Supposing our friend the author owned a tin Lizzie. He may do, for all I know; everybody in America owns a car, judging by the traffic on the roads—and wants to take the family out for an airing on Sunday. He finds the starter battery has run down, so grabs the emergency handle, puts it in the socket without retarding the ignition, and gee! the next thing he knows is when he wakes up in hospital with a fractured skull and broken wrist. But will he argue that because of his calamity auto. engines shouldn't have advanced ignition (in other words, lead)? Nary a bit. He knows full well that for the engine to work efficiently and give its full power the spark *must* take place *before* the piston reaches top dead centre. The reason is, that everything which happens in this world takes TIME. Even the radio juice spends a little between its departure from Brookmans Park and its descent on London aerials; you know it has landed all right, because it blots everything else off the map on most sets. However, that gas in the cylinder takes a certain time to light up; and in order that the full force of the explosion may be available for pushing down the piston as soon as it has passed the centre you have to light the fire a bit early. How soon depends on the speed of the engine.

"Advancing the Ignition" of a Locomotive.

Our friend the author falls into the common mistake of thinking that "lead" on a steam locomotive is provided to act as a buffer for the piston, and help to bring the reciprocating parts to rest easily before they reverse. Well, he's just all wrong; early closing of the exhaust port, and compression of the little wisp of trapped exhaust steam does all the needful in that direction. As with the parallel case of an internal combustion engine, you want to *get the full pressure of steam on the piston as soon as it has passed dead centre*; and so you "advance the ignition," in other words, open the steam port earlier and give her a bit of lead. The steam will take quite an appreciable time to get full pressure in the cylinder; it is nothing nearly so quick in action as the explosion of the automobile engine's charge of gas; and this knocks on the head the argument I have often heard seriously put forward, that the analogy doesn't apply owing to the difference in the high speed of the I.C. motor and the slow revolutions of the steam locomotive. Maybe you will say, then why not "variable lead" on a locomotive, to compensate for speed changes. Well, as a matter of fact, the Stephenson link motion, as is well known, *does* increase its lead as you notch up and gather speed; so much so, that you can run most engines fitted with link motion in either direction with the lever in mid-gear, the lead opening admitting enough steam to keep her going. It is also a significant fact that the two-cylinder "Saints" on the G.W.

have the reputation of being the fastest engines on the road, and they have Stephenson gear.

However, for all ordinary intents and purposes, a fixed constant lead set for the mean average speed of the engine will be found to answer perfectly satisfactorily. Such leads can be obtained with Baker, Walschaerts and other radial gears, by suitably proportioning the top joints of the combination lever and arranging the laps of the valves to suit. One of the reasons why my own engines pull very heavy loads on very little steam is because I pitched the whole of the back-kick calculator's theories into the ash barrel and used a bit of common-sense (or tried to!) plus my own and fellow-enginemen's experiences. And they not only pull, but go like the very dickens. So will any other engine with correct timing. Just wait until we have finished the 3½-gauge quarter-mile continuous road around Mr. Holt's lake, and some of the speed-boaters will have to sit up and take notice. No curve is less than 70-ft. radius, and friend Holt is one of the most confirmed speed merchants I ever happened across; so I guess he will just break the locomotive speed record and make sure he keeps the pieces. No "hot-air" intended.

Lead Does Not Cause "Back-Kick."

The reason why can be simply told. Suppose you have a two-cylinder locomotive with one cylinder nearly on dead centre, the other will be at almost half stroke. Now "Mr. Knowledge" says if you open the throttle or regulator, steam will go into the first cylinder and exert a back thrust, or counter-action, to the steam in the other cylinder. Not on your life! What happens is this. Port on cylinder No. 1 is open to lead; merely a crack. Port on cylinder No. 2 is open as wide as the mouth of a football fan when his side scores the winning goal just as the referee blows his whistle for "time." Bless your soul, the steam has flopped through that cavernous gap, got busy behind the piston (which is in the best starting position) and shoved the other cylinder off dead centre long before the pressure in it has had time to get anything like force enough to do the retarding stunt, much less kick back. Providing the lead and valve setting is correct, *steam will have only attained effective pressure in No. 1 cylinder after the piston has passed dead centre*, and not before.

Our friend the author of the book says his broken-down engine jammed stiff when they gave her steam and tried to pinch her off. Naturally, she did; that is where a little thought comes in useful, as he found when he shut the throttle and opened the cocks to release the pressure. The explanation is, of course, simply that when they gave her steam in the first place, nothing happened in the way of movement because the cylinder was on dead centre, and the other side out of commission; so she just stood still; *meanwhile steam was still flowing in through the lead opening* and finally attained sufficient pressure to hold the engine set. That's all. Had the second cylinder been working, she would have moved off long before that took place. The "anti-leaders" ought to study the arrangement of auxiliary starting ports on some of the modern American limited cut-off engines. On the Pennsylvania Mountain-type which cuts off at 50 per cent. in full gear, there are auxiliary ports 1½ ins. long and ⅛ in. wide, which will admit steam for starting purposes long after the piston-valve has closed the main port. If the engine should stop with one crank on dead centre and one at half stroke, the main port on the latter would have just closed and therefore no steam could enter the cylinder through it, whilst the other side, being on dead centre, would be useless for starting purposes. However, steam will flow through the little auxiliary port, and, after a few seconds, will attain enough pressure behind the piston to start the engine, when, of course, the main valves and big ports will take up the distribution. But the small port still opens earlier and closes later than the main port all the time the engine is running; there is no valve, nor cut-out, nor anything else to prevent it, and none is needed, for the simple reason that once the engine is under way steam cannot pass through the little orifice quick enough to cause excessive lead or back-thrust. The small port area combined with the ordinary lead of the main valves will just pass the right amount of steam to get full pressure as the piston passes dead centre, and can make full use of the power behind it. The "model" calculation merchants and the "anti-leaders" would insist that such an engine with steam ports which open before dead centre will "kick back." Well, they just don't. Anyway, the next loose eccentric engine I build for experiment I intend to make on the limited cut-off system (as she cannot, of course, be notched up with loose eccentrics) and try the effect of a tiny starting port. I guess it will mean a few experiments in drilling tiny holes to get correct size; but the results should be very interesting. One of my client-friends in England for whom I rebuilt three 1¾-in. gauge "poison-gas plants," each of which will now haul an outsize load non-stop for 35 minutes or so on one charge of water, has an ambition to own an engine which will run for an hour non-stop. Said load usually consists of sixteen bogie coaches. I guess a big-wheeled 4—4—0 or Atlantic, with limited cut-off, would do the trick, probably needing only a solitary single-wick spirit (alcohol) burner. His present Atlantic cuts off at 75 per cent. and only needs two wicks to keep going. She has loose eccentrics. The others have full Walschaerts and Southern (American) valve gears.

Stampings for The "M.E." 1 h.p. A.C. Motor.

Readers who are proposing to build the 1 h.p. A.C. motor, full building instructions for which were given in our issues of January 2, 9, 16 and 23 last, will be interested to hear that the Queen's Engineering Co., Halso Works, 60 and 62A, Queen's Road, Battersea, London, S.W.8, are offering to supply the necessary stampings for stator and rotor at 48s., provided twelve sets are ordered. It is therefore up to our readers to place their orders forthwith.

Straight-Fluted Drills.

We are asked to notify our readers that Messrs. H. Brook & Sons, Poulton-le-Fylde, Lancashire, who have recently been advertising batches of straight-fluted drills in our pages, will in future supply eight drills of different sizes, and not one size unless ordered otherwise.

Model Aeronautics.

Model Aeroplane Propellers.

By W. E. Evans (S.M.A.E.)

(*Continued from page* 165.)

Two, Three, or Four-Bladed Propellers?

AGAIN, the thrustometer experiments shed some light on this problem. I will give the actual results of the tests in tabular form next week and leave it to readers to draw their own conclusions. The propellers used in these tests were of small pitch, viz., 10 ins., which accounts for the exceptionally high static thrusts obtained. The type was Chauviere of 10 ins. diameter. All the blades were as near alike as it was possible to make them. The four-bladed propeller consisted of two two-bladed propellers half-lapped together, a tight fit at the boss but the joint was not glued. When the four-bladed propeller had been through the test the blades were separated and the two-bladed propellers were tested separately. These gave identical results which showed that the blades did not differ in size, shape or weight. And, furthermore, a strict comparison can be made between the two-bladed and the four-bladed propeller. The three-bladed propeller had to be made by carving three separate blades and fitting them into a suitable boss. Now for the results. At full output of motor the four-bladed propeller gave a static thrust of as much as $8\frac{3}{8}$ ozs. at 2,150 revs. and the two-bladed $7\frac{3}{8}$ ozs. at 2,750 revs. This shows that three blades absorb more power than two, and four absorb more than three, but not so much more than one might expect. For instance, the four-bladed propeller does not absorb double the power of the two-bladed propeller. At 1,500 revs. the static thrusts were for four blades $4\frac{1}{2}$ ozs., for three blades $3\frac{1}{4}$ ozs., and for two blades $2\frac{3}{4}$ ozs. It would therefore appear that providing there is a sufficient surplus of power to drive a four-bladed propeller, this would give the best results. But, in actual flight, the question of pitch figures very prominently, and it may happen that although the static thrust is more than ample, the forward speed may be insufficient to sustain the model in flight. I must leave it at that.

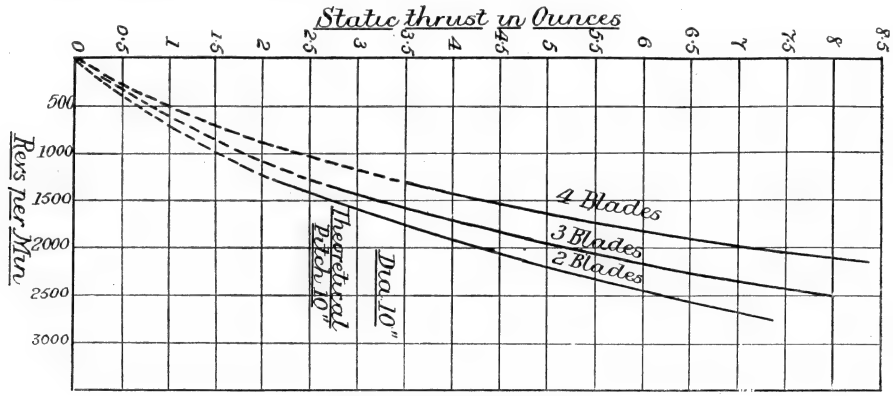
Propeller Pitches.

The static thrust tests show that a small pitch is the most efficient for a given power, but only so far as maximum static thrust is concerned. A small pitch means a small angle of attack from which a greater number of revolutions are obtained. A 10-in. propeller having a pitch of less than $13\frac{1}{2}$ ins. gave a maximum static thrust of $7\frac{1}{4}$ ozs. at full power of motor. When the pitch was 15 ins. or 20 ins., resulting in slower revolutions, the maximum static thrust was only $5\frac{1}{4}$ or $5\frac{1}{2}$ ozs. at most. But this is no criterion of the flying capabilities of the propeller, and I am of opinion that static thrusts are misleading in this respect. It is highly probable that the bigger pitch with resulting smaller static thrust would fly a model best in good weather and give much better duration. However, for flying in very high winds, the small pitch is to be preferred, as, owing to the high revolutions, the speed of the model is increased and greater stability is obtained.

Finding Theoretical Pitch of Propellers.

I venture to say that not half the model flyers know what pitch their propellers really have. A fine, medium, or coarse pitch is about as near as they get to the truth. If a model has a wing-loading of 6 ozs. per sq. ft., the necessary speed required to sustain horizontal flight is 14.7 miles per hour, that is, 1,296 ft. per minute.

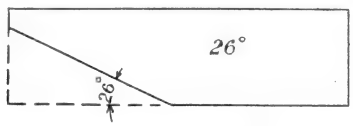
If at the first burst of speed the effective pitch of the propeller produces a forward speed of less than 1,296 ft. per minute, the model will not fly, however great the static thrust may be. It is, therefore, necessary to know whether you are obtaining the necessary forward speed, also to know that this is not excessive, in which case power will be wasted and duration sacrificed. One might as well attempt to get a full-sized aeroplane to rise off the ground by towing it with a caterpillar tractor, the power is ample but the forward speed is lacking. Therefore, it is necessary to know the theoretical pitch of our propellers, and if one allows 20 per cent. for a slip a fair approximation to the forward speed may be obtained, providing we can tell how many revs. per minute the propeller is being driven.



Chauviere Type Propellers.

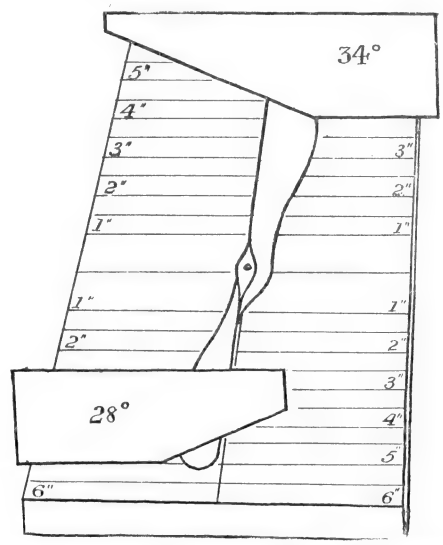
I give below a table of propeller pitches for propellers having diameters from 6 ins. to 12 ins.

A simple method of finding the theoretical pitch of a propeller will now be given. We require for this a *flat* board about 14 ins. long by 7 ins. wide, a nail with head cut off or piece of straight steel wire which will fit comfortably the hole in boss of propeller, and a protractor for measuring angles. It is essential that the board should be perfectly flat, otherwise the angles as measured will not be correct. Drive the nail into the centre of the board and test it with a small set-square to see that it is perfectly upright. If it is not exactly vertical the angles measured will again be incorrect. If a thick propeller spindle is used then a hole should be bored for this which should be a tight fit in the board. Then draw parallel lines across the



Angle Template.

board (not lengthwise) $\frac{1}{2}$ in. apart from the centre to each end so that the angles can be measured at any convenient distance from the centre of boss. Mark at the end of each line its distance from the centre of boss. Now place the propeller on the board with the flat or hollow side of blade uppermost with the nail or pin through the hole. The propeller must run lengthways on the board. Now get some stiff paper or cards (post-cards are very suitable), and cut triangular pieces off one side starting from the middle of the side as in sketch, and mark the number of degrees on the card. It is best if a set of these can be made covering the whole range of angles likely to be required. An adjustable protractor is the ideal instrument for measuring pitch angles, but a description of one of these must be deferred until some future time. Having now got the complete set of angle cards, let us find the pitch of a propeller of, say 12 ins. diameter.



Apparatus used for measuring Pitch of Propellers.

We cannot very well measure the angle at extreme tip of blade, so let us start at $\frac{1}{2}$ in. from tip, that is, $5\frac{1}{2}$ ins. from boss. The angle here will give us the pitch of an 11-in. propeller. The angle here is found to be 26 degrees. Referring to the table of propeller pitches, 11 ins. diameter and 26 degrees pitch angle gives us a pitch of 16.86 ins. Now test again at 5 ins. from boss. We find the angle here is 28

Table of Propeller Pitches.

Pitch angle at tip. Degrees.	DIAMETER.						
	6 ins.	7 ins.	8 ins.	9 ins.	10 ins.	11 ins.	12 ins.
18	6.13	7.15	8.17	9.10	10.21	11.23	12.25
19	6.49	7.57	8.65	9.73	10.82	11.90	12.98
20	6.86	8.01	9.15	10.29	11.43	12.58	13.72
21	7.24	8.44	9.65	10.85	12.06	13.27	14.47
22	7.62	8.89	10.15	11.42	12.69	13.96	15.23
23	8.00	9.34	10.67	12.00	13.34	14.67	16.00
24	8.39	9.19	11.19	12.59	13.99	15.39	17.16
25	8.79	10.25	11.72	13.18	14.65	16.11	17.58
26	9.19	10.73	12.26	13.79	15.32	16.86	18.39
27	9.50	11.20	12.80	14.41	16.01	17.61	19.21
28	10.02	11.69	13.36	15.04	16.71	18.38	20.05
29	10.45	12.19	13.93	15.67	17.41	19.16	20.90
30	10.89	12.70	14.51	16.33	18.14	19.96	21.77
31	11.33	13.21	15.10	16.99	18.88	20.77	22.65
32	11.78	13.74	15.71	17.67	19.64	21.60	23.56
33	12.24	14.29	16.33	18.37	20.41	22.45	24.49
34	12.72	14.83	16.95	19.07	21.19	23.31	25.43
35	13.20	15.40	17.60	19.80	22.00	24.20	26.40
36	13.70	15.98	18.26	20.54	22.96	25.11	27.39
37	14.21	16.57	18.94	21.31	23.67	26.04	28.41
38	14.73	17.18	19.64	22.09	24.55	27.02	29.46
39	15.26	17.81	20.35	22.90	25.44	27.98	30.51
40	15.82	18.46	21.09	23.73	26.37	29.00	31.63
41	16.39	19.12	21.85	24.58	27.31	30.04	32.77
42	16.97	19.80	22.62	25.46	28.29	31.12	33.95
43	17.58	20.51	23.44	26.37	29.30	32.22	35.15
44	18.21	21.24	24.27	27.31	30.24	33.38	36.41
45	18.85	21.99	25.14	28.28	31.42	34.56	37.70

degrees, which is equal to a 10-in. diameter propeller with a tip angle of 28 degrees. Referring again to the table, we get a pitch of 16.71 ins. at that point. Continuing the same process at $4\frac{1}{2}$ ins. from boss, the angle is 31 degrees and the pitch 16.95. At $3\frac{1}{2}$ ins. from boss we get $37\frac{1}{2}$ degrees and 16.87 ins. pitch. At 3 ins. from boss, 42 degrees and 16.97 ins. pitch. Averaging these out, we get a theoretical pitch of approximately 16.9 ins.

(*To be continued.*)

Society of Model Aeronautical Engineers. Annual Prize Distribution.

The annual prize distribution of the S.M.A.E. took place at the Y.M.C.A., Tottenham Court Road, on Tuesday, February 4. Dr. A. P. Thurston (Vice-President) presented the prizes to the following successful competitors:—

Gamage Cup.—1st, D. A. Paveley, silver medal; 2nd, T. H. Newell, bronze medal; 3rd, W. E. Evans, diploma.

Kite and Model Aeroplane Association Cup.—1st, D. A. Paveley, silver medal; 2nd, W. J. Plater, bronze medal.

The Model Engineer No. 2 Cup (gliders).—1st, C. J. Burchell (T.M.A.C.), silver medal; 2nd, W.E. Evans, bronze medal; 3rd, R. J. Davis (T.M.A.C.), diploma.

Pilcher Cup.—1st, J. E. Pelly-Fry, silver medal, 10s.; 2nd, D. B. Mincher, bronze medal; 3rd, W. E. Evans, diploma.

International Cup.—Fifty-guinea cup and first prize presented by Sir Charles Wakefield, Bt., won by the S.M.A.E. for Great Britain. 1st, R. N. Bullock, £10; 2nd, D. A. Paveley, £1; 3rd, T. H. Newell, 10s.

Farrow Shield (inter-club contest).—Won by Halton Model Aircraft Society.—Silver medallists, Plater, Turner, Twiggs; bronze medallists, Passingham, Barker, Osborne.

Freshmen's Competion.—1st J. van Hattum, £1; 2nd, A. M. Willis (T.M.A.C.), 10s.! 3rd, B. K. Johnson, 7s. 6d.

Notices' Competition.—1st prize, membership of the S.M.A.E., for 1930, won by R. Haines.

Photographic Competition.—1st, S. R. Badley, 10s.

After the distribution of prizes, the following dates were fixed for the 1930 competitions:—

Gamage Cup, March 29, Wimbledon Common.
K.M.A.A. Cup, April 12, Wimbledon Common.
General Flying Display, April 21 (Easter Monday), Wimbledon Common.
Pitcher Cup, April 26, Wimbledon Common.
The Model Engineer Cup No. 2, May 10, Sudbury.
Flight Cup, May 24, Wimbledon Common.
General Flying Display, Whit Monday, Sudbury.
Sir John Shelley Cup, June 14, Wimbledon Common.
Lady Shelley Cup, July 12, Dawson Park, Bexley Heath.
Weston Cup, July 26, Wimbledon Common.
The Model Engineer Cup No. 1, August 23, Wimbledon Common.
S.M.A.E. Cup, September 27.
Freshmen's Competition, October 8, Wimbledon Common.
Visitors' Competition, October 15, Wimbledon Common.

Hon. Secretary, S. G. Mullins, 72, Westminster Avenue, Thornton Heath, Surrey.

The Model Aircraft Club (T.M.A.C.)

At the Junior Institution of Engineers, 39, Victoria Street, S.W.1, on Wednesday, March 19, an interesting debate has been arranged between Mr. D. A. Pavely, the Technical Adviser of T.M.A.C., and Mr. C. A. Ripon, the subject being "Mechanically *versus* Rubber-Driven Model Aeroplanes."

Hon. Secretary, A. E. Jones, 48, Narcissus Road, West Hampstead, London, N.W.6. 'Phone, Hampstead 8363.

The Model Aircraft Construction Society.

The modifications to the glider have now been commenced, consisting of a new fuselage front portion, new control pedals, decreasing area of tail, and refitting chassis; it is hoped to complete the work very soon, and be one of the first clubs to do active gliding again in this country.

Models.

Two members, Mr. Marshall and Mr. Lowe, have been out flying almost every week-end in rather bad weather. The former has flown a duration model, using "Clark Y section" wing, logging 30 secs. to date, hand launched. The greatest event, without doubt, was the appearance of this member's large model (rubber driven) for initial tests, which spans all but 8 ft., using a *wing* and *tail* section of purely bi-convex form. This machine flew quite steadily on several short flights, and promises well for the future, when more power is added, and other air-screws tried. The writer has been flying his "Quicksilver II," performing consistently, one flight terminating in the floods, when a member looking on promptly waded in for this model. It is hoped other members will shortly come along with new machines and assist in these interesting efforts.

Hon. Secretary, F. A. Lowe, 24, Bramcote Road, Beeston, Notts.

Correspondence.

A Model Seaplane Base Wanted.

Dear Sir,—With reference to Mr. Lowe's letter in January 6 issue of The Model Engineer, I would like to say that I am at present working on a description of the seaplane which will be ready I hope before long. The original design is being slightly altered to bring the model up to date. As regards the query as to whether the model ever took off from the water or not, I can only say that owing to lack of a suitable sheet of water that was calm enough for so small a model, the model was always flown hand launched. Personally, I am quite convinced that the machine would take off if given the opportunity to do so, as it is only a question of increasing the power. This, however, should not be necessary.

While on the subject of seaplanes, I would be most grateful to any reader who could inform the S.M.A.E. of a good seaplane flying ground that they happen to know of, as, owing to the lack of one, the seaplane side of model aeronautics is being neglected. This is a great pity, as a model seaplane can offer more interest to the aero-modeller than can a landplane.

So let us hope that someone will come to the rescue with a suggestion for a good seaplane base.—Yours sincerely,

J. E. Pelly Fry.

QUERIES and REPLIES

Querists must comply with the Conditions and Rules given with the Query Coupon in the Advertisement Page of each issue.

Selections from Queries recently replied to.

3533. Winding a $\frac{1}{8}$-h.p. A.C. Induction Motor.—H. W. (Camberwell, S.E.).

Q.—I enclose a tracing of an A.C. stator stamping which I want to use in making up a squirrel-cage motor to run on 200 volts 50 cycles as a six-pole machine, at a speed of about 1,000 revolutions per minute. I shall be obliged if you will give me a specification for the starting and running windings, and tell me what power to expect. It will be started with a " twinob " switch.

A.—The stator stampings appear to be $5\frac{3}{4}$ ins. overall diameter, with 24 slots $\frac{3}{4}$ in. deep, tapering from 9/32nd in. to $\frac{3}{8}$ in., the slot opening being 1/16th in. These are to be built-up to a depth of $2\frac{1}{4}$ ins. The rotor is of the squirrel-cage type, also $2\frac{1}{4}$ ins. long and built-up with 31 copper bars. At 1,000 revolutions per minute, less 4 per cent. slip on full load, that is 960 revolutions, the power output will naturally not be very large, and $\frac{1}{8}$ h.p. would be a fair estimate for a continuously rated motor to these dimensions. If provided with a very efficient cooling fan, it might be possible to rate it up to $\frac{1}{6}$ h.p., or even to $\frac{1}{4}$ h.p. for short periods such as half an hour, but everything depends on the efficiency of the cooling arrangements in these small motors. As a six-pole stator, there will be four slots per pole, both for the starting and the running coils. Put on the running winding first with two coils per pole, the coils wound concentrically and each coil consisting of 50 turns of No. 22 S.W.G. 6 mil. D.C.C. copper wire. All coils are to be connected in series with one another, each pole group changing from north to south in succession all round. There will be sufficient room in the slots for the starting winding to follow on, but the coil will, of course, be displaced by half a pole-pitch to give the " split-phase " starting effect. About 70 turns of No. 28 S.W.G. 6-mil. D.C.C. per coil will give a starting torque equal to the full load running torque.

3496. Charging Dynamo for H.T. Battery.—C. L. D. (Totton).

Q.—I thank you for your former reply to my query, and have looked up the winding tables in the articles on rewinding car dynamos in THE MODEL ENGINEER for September 12 and 19, 1929, as advised. I do not, however, find any data suitable for my particular requirements, and should be grateful for a little further help.

A.—This correspondent has an aero-dynamo with an armature $2\frac{1}{4}$ ins. diameter by $2\frac{1}{2}$ ins. long, running in a two-pole field magnet. There are 14 slots in the armature and 28 bars in the commutator, so that each slot will need two coils; in other words, there will be 28 armature coils in all, grouped two per slot. It is desired to wind this dynamo suitably for recharging a 120-volt high-tension accumulator, the charging rate being $\frac{1}{8}$ ampere, and to allow for the rise in the back E.M.F. of the battery when fully charged the dynamo should be capable of developing 150 volts 0.125 ampere. There is no winding actually suitable for this output in the tables referred to, as these only include ordinary standard voltages, whereas the present output asked for is intermediate. There is no reason why this dynamo should not run quite well at 150 volts; the object in omitting high voltages from the above-mentioned table of windings was owing to the small number of commutator bars usually associated with small armature dimensions, but as the present commuator has 28 bars, it should give a perfectly good performance on 150 volts. The following winding specification is recommended: armature, 14 double former-wound coils, consisting of 75 + 75 = 150 turns of No. 31 S.W.G. double silk covered copper; fields, two coils, each containing 3,500 turns of No. 34 S.W.G. single cotton covered copper, the two field coils being in series with one another and shunt connected to the armature. Carbon brushes of " Link A " grade will be best, about $\frac{1}{4}$ in. by $\frac{1}{4}$ in. section or equivalent, two brushes only being used at 180 deg. apart on the commutator, and no intermediate brush. The sketch of the proposed armature windings and commutator connections submitted is not quite correct. The span of the coils in the armature slots should be one slot less than the exact half circumference, and the point of attachment to the commutator bars is governed by the relation between the centre lines of the field magnet poles and the brushes respectively. The method of laying out the connections, and former-winding an armature will be found illustrated and explained in detail in Chapters IX and X of " Dynamo Design and Construction," by A. H. Avery.

3499. Winding a Multiple Secondary Transformer.—H D. H. (Enfield Wash).

Q.—I should be glad if you would give me some information concerning the winding of a transformer. I enclose a dimensioned sketch of the core which I wish to wind for a primary input of 240 volts 50 cycles. The secondary is to work in conjunction with a full-wave mechanical rectifier for charging accumulators at 3 amperes and 5 amperes rate, there being two windings which I wish to give as high a voltage as possible.

A.—The output obtainable in volt-amperes is, of course, governed by the core dimensions together with the supply frequency. Unfortunately, the sketch submitted of the core has not been fully dimensioned, but assuming that it is approximately to scale, the iron section appears to be $\frac{3}{4}$ in. by 1 3/16th ins., say 0.89 sq. in. At 50 cycles frequency the maximum loading for a core of this size, continuously rated and without exceeding permissible temperature limits will be about 50 volt-amperes. This fixes the secondary output at 5 amperes 10 volts for one winding, and 3 amperes 16 volts for the other winding, assuming that only one secondary is in service at a time. The reactance voltage for a core of this size is nine turns per volt. The 240-volt primary will accordingly require a coil consisting of 2,160 turns of No. 28 S.W.G. 6 mil. D.C.C. copper. If two independent secondary coils are required, the first or 16-volt 3-ampere coil will need 144 turns of No. 17 S.W.G. D.C.C. copper, and the second 10-volt 5-ampere coil 90 turns of No. 15 S.W.G. ditto. As to there being any advantage in winding primary and secondary coils side by side instead of one over the other, it is a matter affected by their relative positions. The side-by-side position is not so good as one over the other if all the primary is on the right and all the secondary on the left; but if the primary coil is split into two and the secondary sandwiched in between them, the voltage regulation between full load and no load will be distinctly improved.

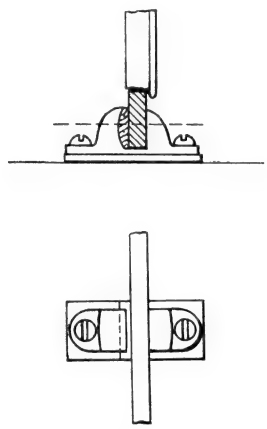
Answer to Correspondent.

H. N. (Stamford Hill).—You will find the information you require in Calvert's Mechanics' Almanac, 1930, price $7\frac{1}{2}$d., post free, from our Publishing Department.

PRACTICAL LETTERS from OUR READERS

Track for Large Scale Railway.

DEAR SIR,—In response to Mr. Buick's letter *re* track for large-scale locos, the enclosed sketch shows how I dealt with mine for a 2-in. scale (10¼-in. track); the rails are ordinary 1¼-in. by ⅜-in. flat mild steel bars, and these are secured to cast-iron chairs; these in turn are fixed to sleepers by stout galvanised screws.



Sketch of Rail and Chairs used by the Writer.

Wooden sleepers do not last (even if treated). I have adopted concrete measuring about 16 ins. by 3½ ins. by 2½ ins. deep, and the chairs are held by letting the screws into the concrete whilst wet.

The sketch is quarter size of my chairs, and I suggest that the chairs be strengthened immediately below the rail, the strain of the oak wedge together with the impact of the train is liable to fracture the chair.

The oak wedge might be dispensed with and a set-screw or pin used instead of the wedge, as indicated by dotted line; the wedges do work loose.—Yours faithfully,

R. A. BRIGGS.

DEAR SIR,—If utility and not appearance is the more important, your correspondent from New Zealand, or anyone else who is seeking a suitable rail for passenger-carrying model locos, cannot do better than use unequal-sided angle steel, say ¾ in. by ½ in. I have obtained this from Mr. J. Heath in 5-ft. lengths, screwing it down through the widest side, and do not think that anything more suitable could be wished for.—Yours faithfully,

H. B. GREEN.

Steam Cars.

DEAR SIR,—I have read your article on the Doble steam car with considerable interest. I am a steam enthusiast, having built and run a steamer on the road soon after the repeal of the Red Flag Act (Mr. Robert Lamb will well remember it running through the end of his new garage at St. Albans), since then I have had a 10, 20 and a 30 h.p. Stanley, and am not too old to go on with steam again if a good, reliable car is produced; there is nothing to compare with the pleasure of driving a steam car.

Something smaller than the Doble is needed for this country, say a car of the Morris size; 12 h.p. steam is ample; my 10 h.p. could do 75 m.p.h. on a good stretch of road.

I should suggest a small two-cylinder simple engine for preference; the general lay-out of the Doble is much the same as the Stanley; engine suspended horizontally from the frame and geared directly to the road axle, boiler under bonnet, etc.

With high-pressure highly superheated steam, I am surprised to see piston-valves and link motion retained; the whole tendency in steam, both loco and road transport, is to use poppet valves.

The horse-power tax on a boiler of 80 ft. of heating surface will, I fear, prevent a car such as you illustrate being a practical proposition in this country. I am sure there is a certain market for a smaller and lighter steamer. We don't want 90 to 95 m.p.h., the whole thing cut down, say 50 per cent. would be ideal.—Yours faithfully,

R. A. BRIGGS.

Defining the Hydroplane.

DEAR SIR,—I have followed the discussion on hydroplanes and their action with great interest, but, though Mr. A. C. Davison keeps the subject warm, whilst "Tandem" draws his penwiper thoughtfully across the cat, I am afraid, so far, no No. 8 hat has actually suggested a complete explanation of why "she planes." As swords are not usually sheathed in MODEL ENGINEER questions like this until some really easily understood explanation is forthcoming, I timidly suggest that the following has some bearing on the subject, besides speed! At a *certain* speed the relative angle of even a displacement boat's forepart causes it to rise, and, in the case of a 'plane, there is a vacuum formed under the step. The water attempting to fill this strikes in an *upward* direction at the rear portion of the hull—the direction of thrust being diverted towards the rear by the relative speeds of hull and water, until it approximates 45° or thereabouts. This is counteracted by the downward draught or "suction" action of the propeller keeping the stern down, which, of course, strictly speaking, is the action of the water flowing to fill the vacuum

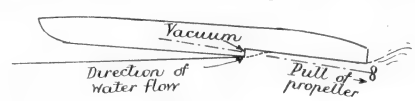


Diagram illustrating Hydroplane Planing.

formed by the displacement of propeller. The net result is that the boat is propelled forward with a greatly *decreased* friction.

As a proof that the propeller suction is one of two balanced forces, note the number of times a 'plane will nose dive if the propeller comes out of rough water. The rough sketch will, I trust, explain my meaning.

Apropos this, I have heard it suggested that a column of air is used under step as a "roller bearing." Hoping that the shadows of THE MODEL ENGINEER and its contributors never grow less.—Yours truly,

W. H. WILCOCK.

An Appreciation from Shetland.

DEAR SIR,—As a reader of THE MODEL ENGINEER from the time of its first appearance, and noticing in your issue of January 2 that you reach your fifteen hundredth number next month, I feel it a duty as well as a pleasure to offer you my sincerest congratulations on the continued and increasing success of one of the cleanest little magazines published in this, and, I venture to say, any other country.

What it has been to me all these years I feel it impossible to define. It has helped me in those many little engineering difficulties which so often perplex

amateurs. In such a distant corner of the British Islands as this, so far removed from a town, one has to tackle little jobs about one's motor bicycle or car, not to mention repairs sent in from the culinary and other domestic departments, at a moment's notice. Indices of back numbers are looked over, likely informative articles are turned up, and help is always available.

Not only in this direction is "our magazine" so helpful. Its literary style is an education in English composition to all those who wish to improve the expression of their thoughts on paper.

To individualise your contributors would be as obnoxious to them as to yourself, yet I do not suppose I will commit any serious indiscretion if I say how we all benefit from reading your editorial remarks from the literary point of view, nor will I err when I refer to Mr. Chas. S. Lake, Mr. A. H. Avery, or Mr. Fred Taylor, and other constant contributors, as examples of clarity of expression, and pure English, nor can I omit a reference to the sparkling wit of "L.B.S.C." and the very practical way he explains how to carry out correctly machining processes in the making of parts of model locomotives and many other things. Fain would I mention others of the past whose articles I re-read with ever fresh delight.

The chief value of "our magazine" to me at my time of life is that it carries me back to a time when I spent so many happy hours in my little workshop "making tools," as my wife and others expressed it, "to make something else with." I can remember with what pride I succeeded in making a circular die from an old flat file, and how elevated I felt when the Editor accepted a description of a little milling cutter I made, reproduced a photograph of it, and awarded me one of his prizes, to my great delight.

In conclusion, I gratefully remember the help I have received from your editorial staff when in a difficulty, and I wish your magazine with you at its head many many years of continued success.—Yours sincerely,

HENRY P. TAYLOR.

Shetland.

Address Wanted.

WILL "Another Lieut.-Colonel," whose letter appeared in our February 6 issue, kindly supply us with his present address. We have a letter from a reader for him at our office.

Institutions and Societies.

The Society of Model and Experimental Engineers.

MEETINGS.—At Caxton Hall, Westminster, at 7 p.m. To-night, a lecture by B. E. Dunbar Kilburn, Esq., M.A. (member), on "Tides." This interesting lecture will be illustrated by lantern slides. Please do not forget that this is a ladies' evening, and it is up to every member to bring a lady. Friday, March 7, Competition, Track and Model Night. Cards of admission to this meeting are not offered to those readers of THE MODEL ENGINEER who received invitations to the last track night, but any reader who has not attended before and would like to see some high-class models at work, both stationary and locomotive engines, may have a ticket by writing to the Secretary for one.

DINNER.—As already announced, the Annual Dinner of the Society will be held at Pritchards' Restaurant on Saturday, April 5. Tickets, price 7s. 6d. each, may be obtained of the Secretary or of any member of the Council.

WORKSHOP.—Please see last week's issue for full particulars of a demonstration on "Mottling," by Colonel A. F. Marchment, D.S.O., M.C., T.D. Will any other member offer a demonstration?

On Monday, March 3, Rummage Sale.

Information on any matters pertaining to the S.M.E.E. may be obtained from the Secretary, R. W. WRIGHT, 202, Lavender Hill, Enfield, Middlesex.

St. Helens and District Model Engineering Society.

A meeting will be held on Thursday, February 20, at 7.45 p.m. Will all the old members kindly attend? Anyone in St. Helens and district who is interested in model engineering will be made welcome on this night. It will be held at 44, Rigby Street. St. Helens.

Further information can be had from W. TAYLOR, Secretary (*pro. tem.*), 44, Rigby Street, St. Helens, Lancashire.

Manchester S.M. and E.E.

NEXT MEETING.—February 21, at the Manchester Technical Schools, Whitworth Street, Manchester, at 8 o'clock.

There will be a certain amount of space for any advertisers in THE MODEL ENGINEER to show their goods. I should be glad to hear from any firm interested; also other model enginering societies.

Hon. Secretary and Treasurer, W. E. WOOD, 20, Albert Place, Longsight, Manchester.

The Sheffield Society of Model Engineers and Sheffield Model Railway Club.

The Sheffield Club is making rapid progress, and a club room has now been obtained where a library, lathe and other tools and a track will shortly be available. The room, situated at 33, Red Hill (off Broad Lane), Sheffield, is open, apart from regular meetings, on Tuesdays and Saturdays from 6 to 10 p.m., when members and visitors are heartily welcome.

Hon. Secretary, J. H. WOOLLEY, 173, Watt Lane, Crosspool, Sheffield.

Notice.

The Editor invites correspondence and original contributions on all small power engineering, motor and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected, or not, and all MSS. should be accompanied by a stamped envelope addressed for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., Ltd., 66, Farringdon Street, London, E.C.4. Annual Subscription, £1 1s. 8d., post free to all parts of the world.

All correspondence relating to Advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 66, Farringdon Street, London, E.C.4.

Sole Agents for United States, Canada and Mexico: Spon and Chamberlain, 120, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed. Single copies, 14 cents; annual subscription, 5 dollars 50 cents, post free.

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"SALES AND WANTS."

"General"—(*Continued from page* iv.)

Ball-bearing Races, Hoffmann, Skefko, slight imperfections, satisfactory, usable, ½", ⅝", ¾", 1⅛", 12 mm., 15 mm., 17 mm., 20 mm. bores, from 4d. pair, 2d. postage. List sent.—18, Galton Street, Smethwick.

Power Lathe, massive 6" lathe heads, 4 speeds, on 5-ft. 6 bed, rest, faceplate, 59s. gets it.—Below.

Every Mechanic At It. Building Butler's ½ h.-p. Petrol Engine. Castings, part tooled, 9s. 9d. Catalogue 3d.—BUTLER'S GARAGE, Littleover, Derby.

"Model Engineer," January, 1924, to June, 1929, 11 vols. as new, vols. 1 and 2 bound, 35 early numbers; also Metre Paddle Steamer Hull, *M.E.* design, sponsons and paddles fitted; £4 the lot; would separate.—WELFORD, Lymm, near Warrington.

Pulleys, Shafting, Plummer Blocks, Gear Wheels, Belting; also cheap Electric Lamps.—SWINNOW ENGINEERING Co., Bramley, Leeds.

Four Loco Driving Wheels, 2⅜" diam., 4-wheel bogie, frames, smoke-box, 7s. 6d.; new 4-volt 25-amp. Accumulator, 7s. 6d.; six new 12-volt Lamps, 12s. 6d.; Headphones, 5s. 6d.; ditto, 2s. 6d.; Wireless Parts cheap; offers; particulars, stamp.—"Montrose," Beech Road, Rushmere, Ipswich.

Pressure Gauges, reading 120 lb. sq. in., 1½" dials, 1s., post 3d.—Below.

Powerful Double Convex Optical Lenses, 4½" diam., 2s. 6d., post free.—Below.

Watchmaker's Eye Glasses, very powerful, usually 2s. 6d., now 1s. 3d., post free.—"AUTOLEX," 53, Crofts Road, Kenton, London.

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Cinematograph Films and cheap British-made Machines, Accessories; list free.—"FILMERIES," 57, Lancaster Road, Leytonstone, London.

"Working Your Home Cinema." Useful information. Free lists, cheap Machines, Film Library.—"WAYLAND," 109, Kenlor, Tooting.

Semi-Professional Cinematograph, new model, gears, sprockets, etc., solid brass, complete electrical equipment, with batteries, all complete with spools, films, screen; cost £20; sacrifice £12 or nearest offer; must be sold.—Box 1371, MODEL ENGINEER Offices.

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Models Built, Repaired, Exchanges; speciality—Locomotives.—SALLIS, Mayfield Grove, Nottingham.

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3½" Gauge Rolling Stock, bogie parcel van, bogie high capacity wagon, four-wheeled brake van, and coal wagon. What offers?—LEE, 20, Hulme Hall Road, Cheadle Hulme, Stockport.

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"Electric Accumulators," by Bernard E. Jones, dealing with their construction and management, with special reference to using and charging wireless accumulators. Price 1s. 8d., post free.—PERCIVAL MARSHALL & Co., LTD., 66, Farringdon Street, London, E.C.4.

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Wolseley Stellite-made Vickers, 3-speeds and Reverse, excellent condition, most reliable, Lucas lighting set, electric horn, dickey, any trial quick sale £15.—DANIELL, 38, Badminton Road London, S.W.12.

LIGHT MACHINERY Sales and Wants

"SALES AND WANTS."

(*Continued from page* vii.)

Tools

Lathes.—Britannia, C.A.V., Drummond, Edgar, Eta, Exe, Milnes, Patrick, Wade, and all leading makes in stock.—BUCK & RYAN, 310-312, Euston Road, London.

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(*Continued on page* x.)

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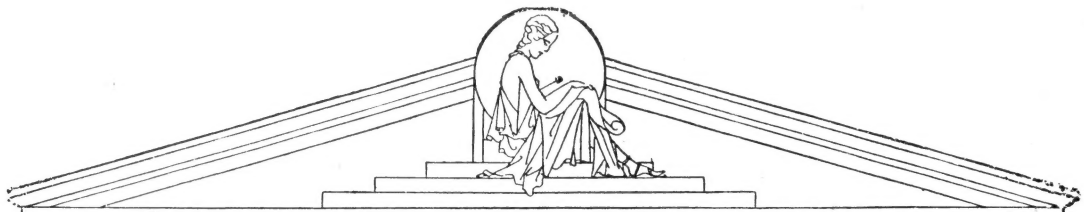

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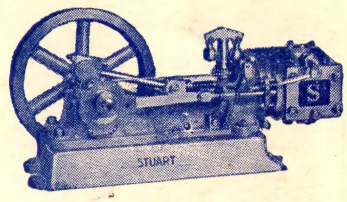

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